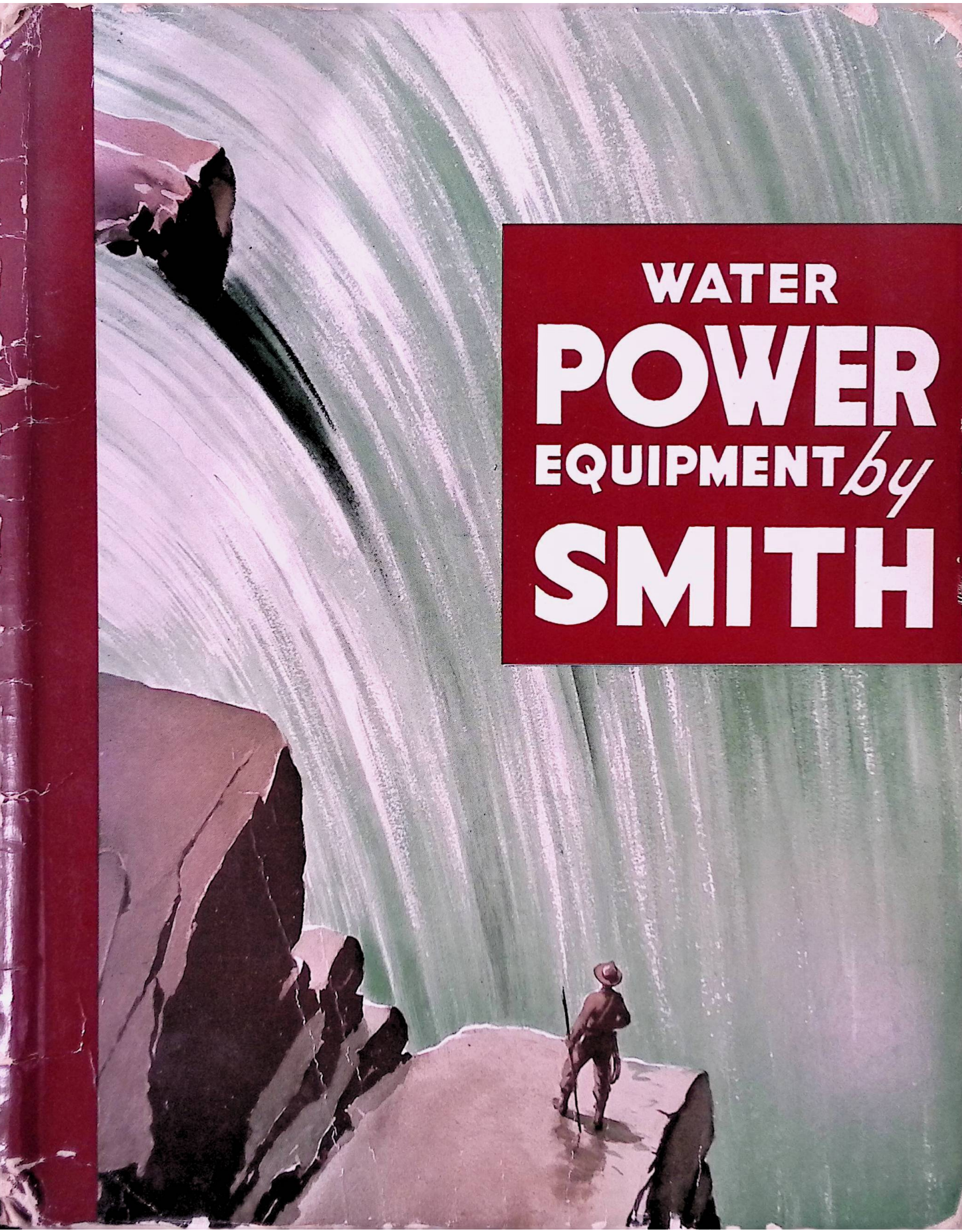
WATER
POWER
EQUIPMENT by
SMITH

BULLETIN NO. 151

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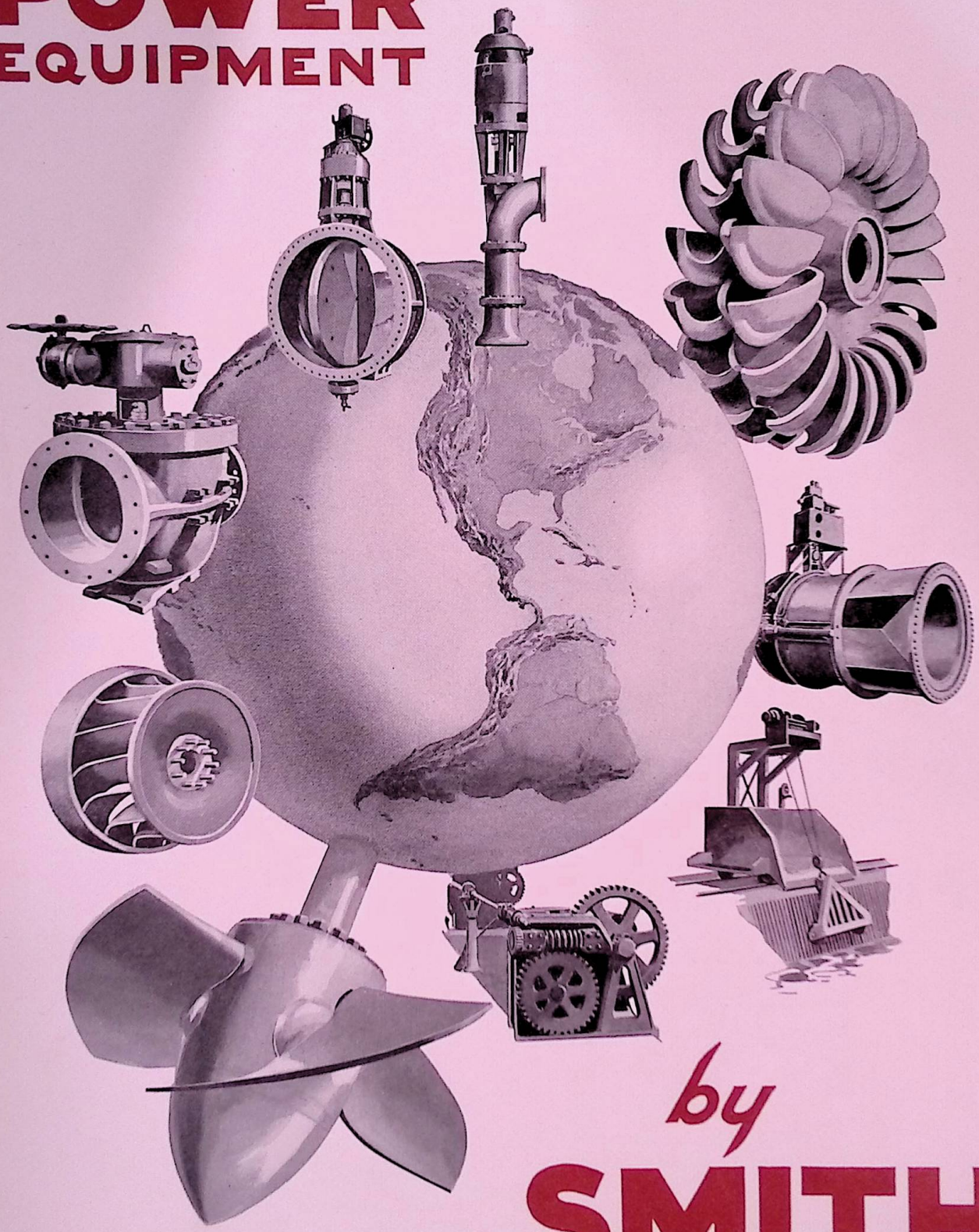
WATER POWER EQUIPMENT



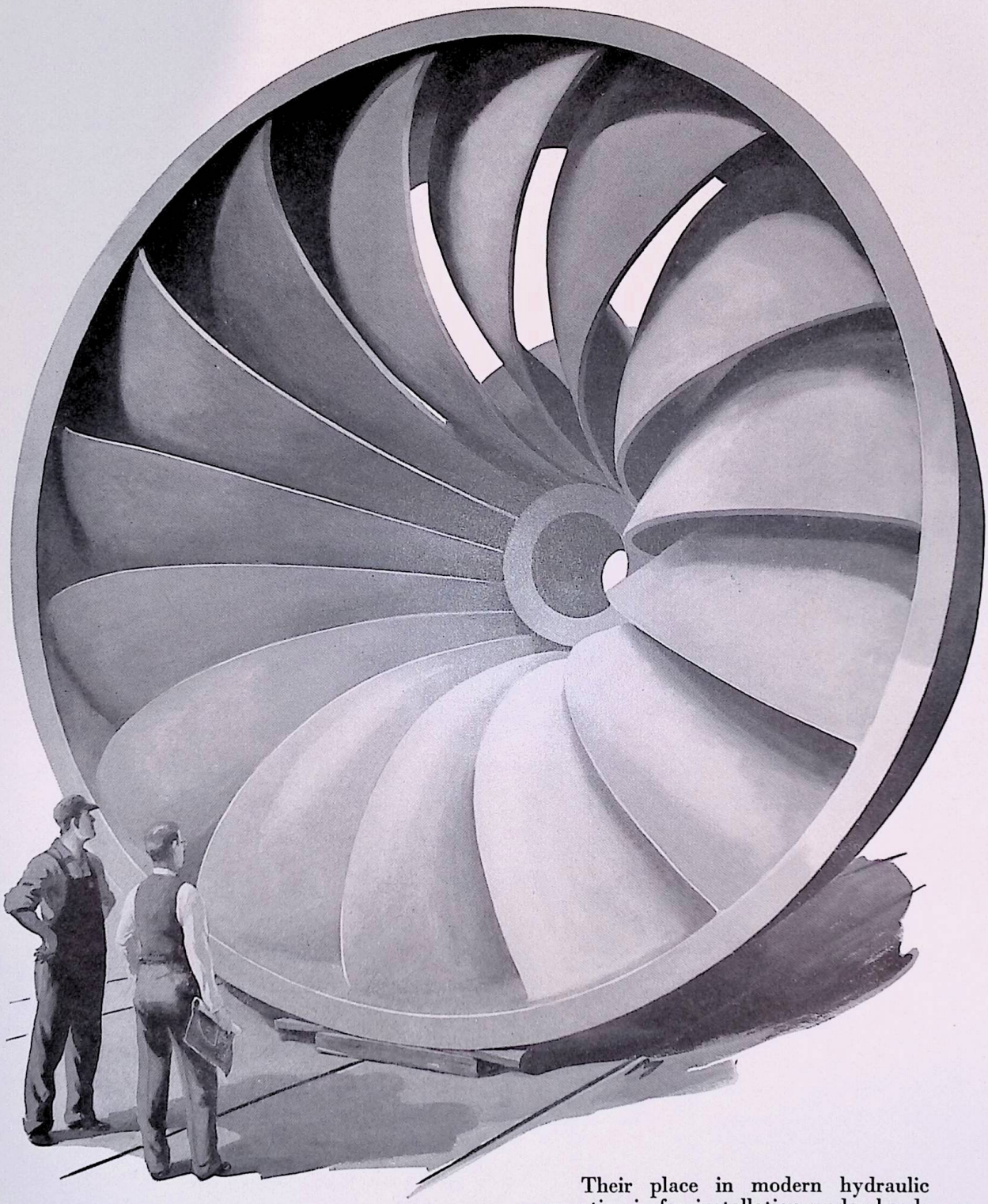
by

SMITH

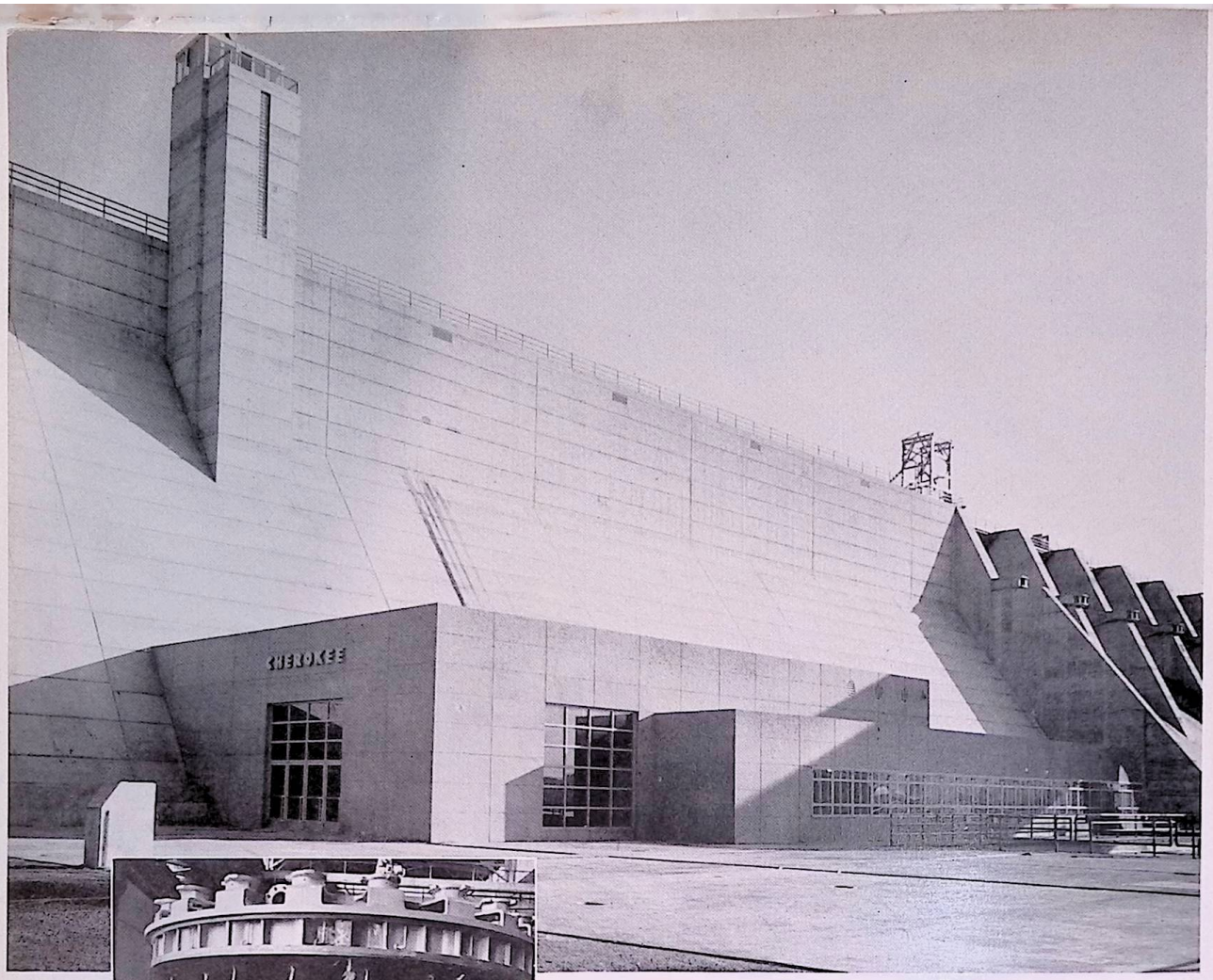
PIONEERING *in Hydraulic* POWER –

POWER leads civilization. "Power by SMITH" symbolizes seventy-five years of successful experience in the manufacture of hydraulic turbines and related equipment—turbines installed of more than 12 million horsepower capacity! This Bulletin records this achievement, and the size and scope of the operation, in pictures rather than words.

FRANCIS Turbines



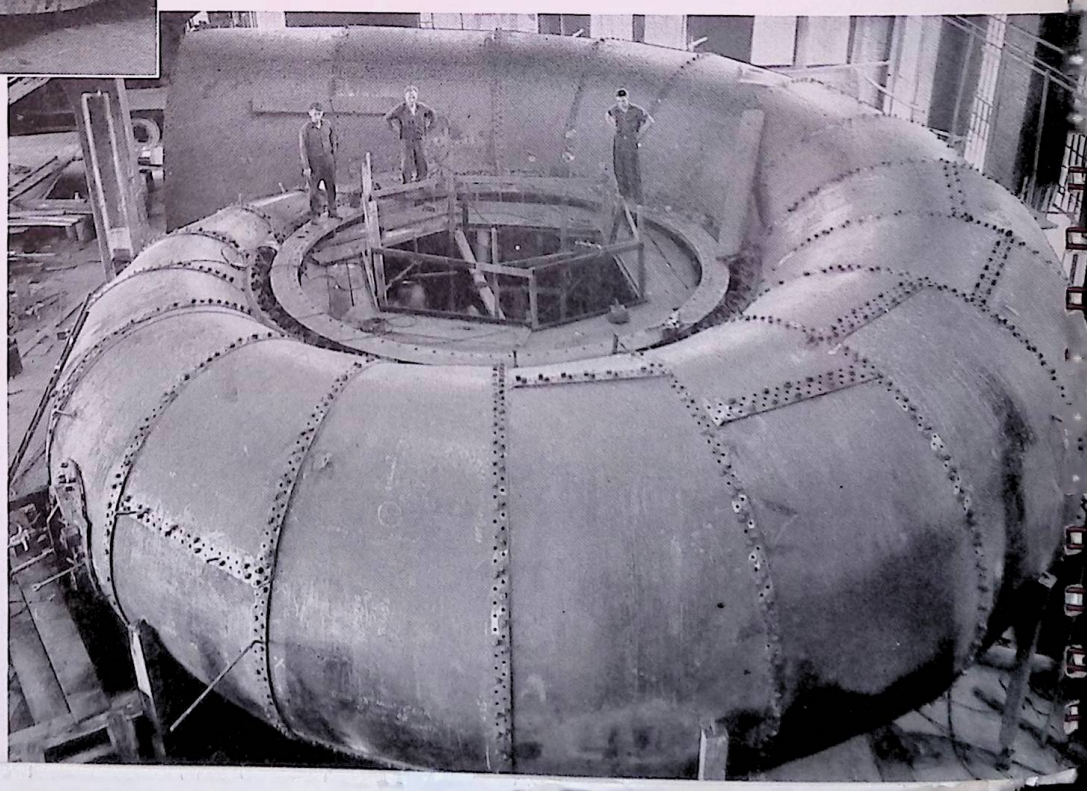
Their place in modern hydraulic practice is for installation under heads of from 75 to 1000 feet.

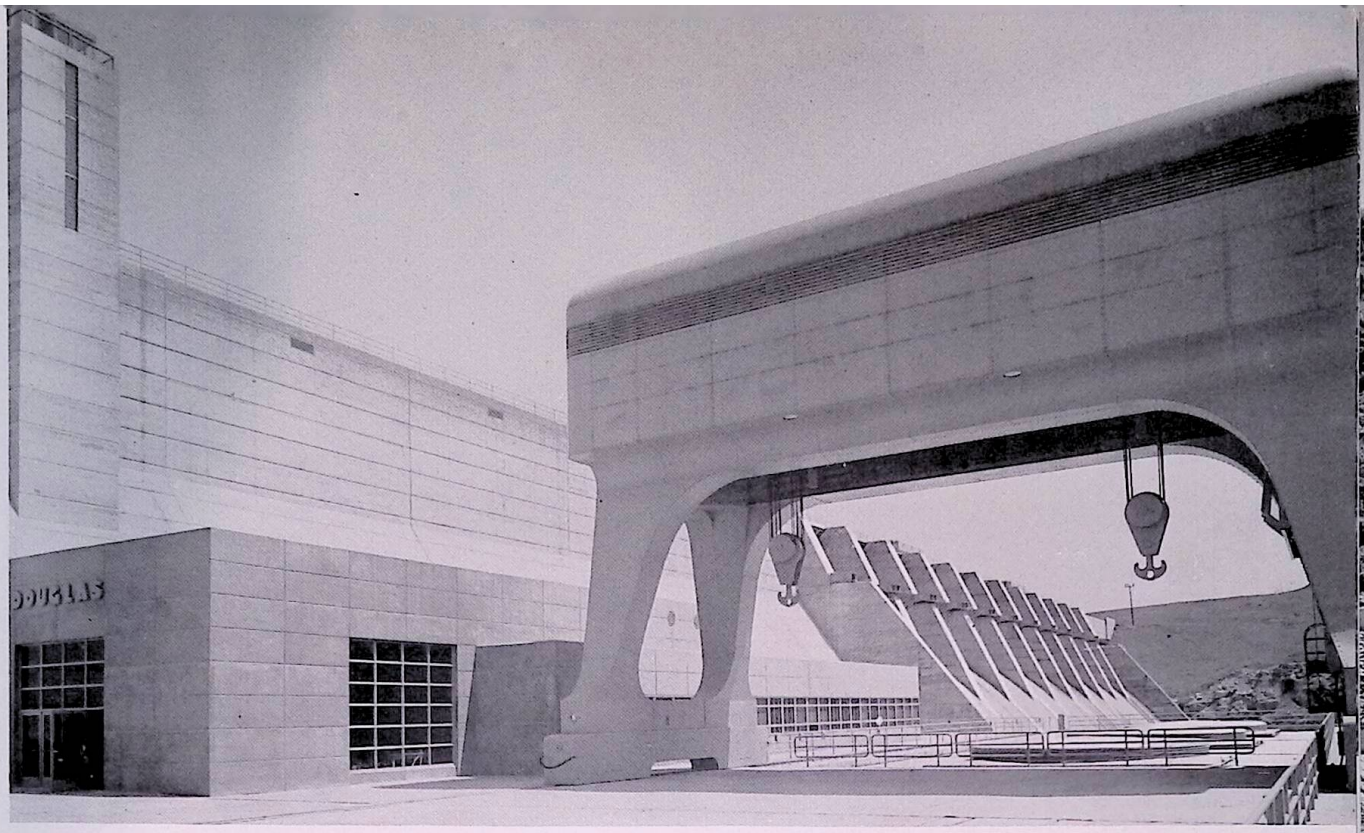


● Cherokee Dam of the Tennessee Valley Authority on the Holston River. Initial installation consists of two 50,000 H.P. Smith-Francis turbines operating under 125 feet head, 94.7 R.P.M.

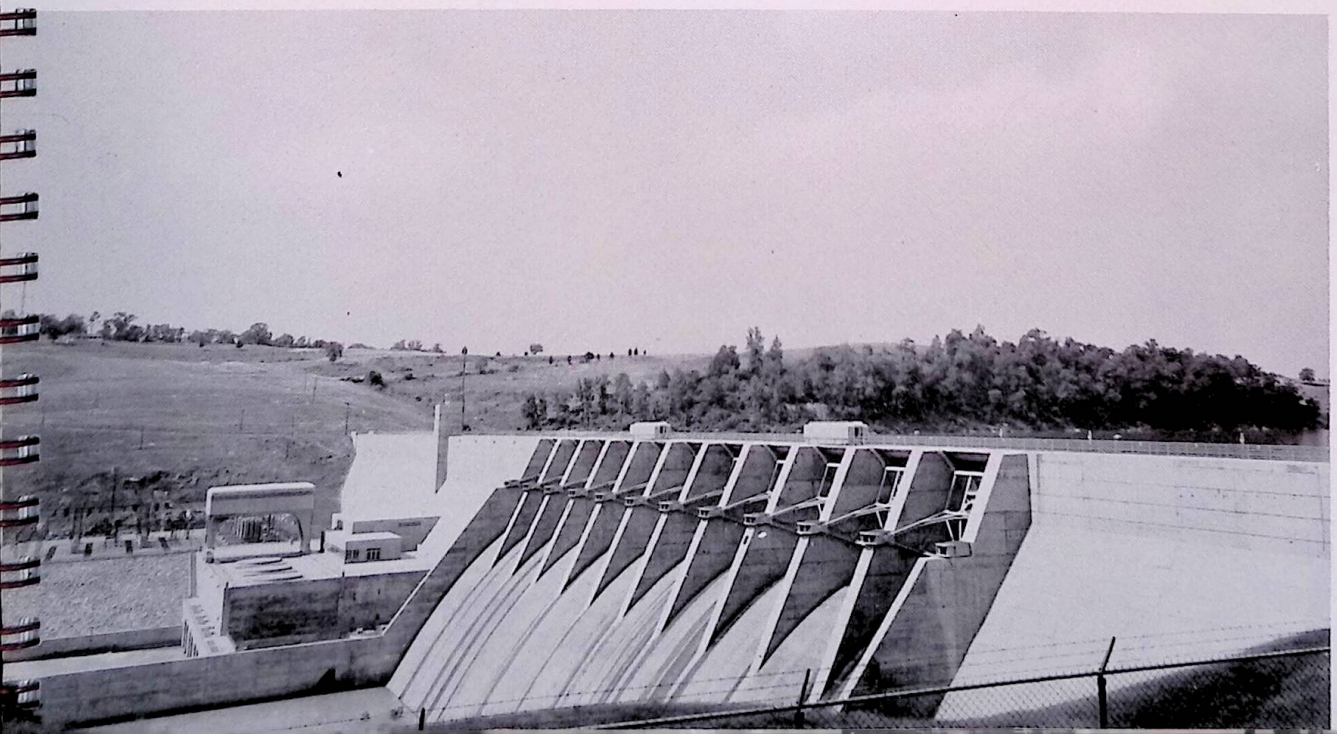
● Above: 120,000-pound runner assembled with head cover and bottom ring.

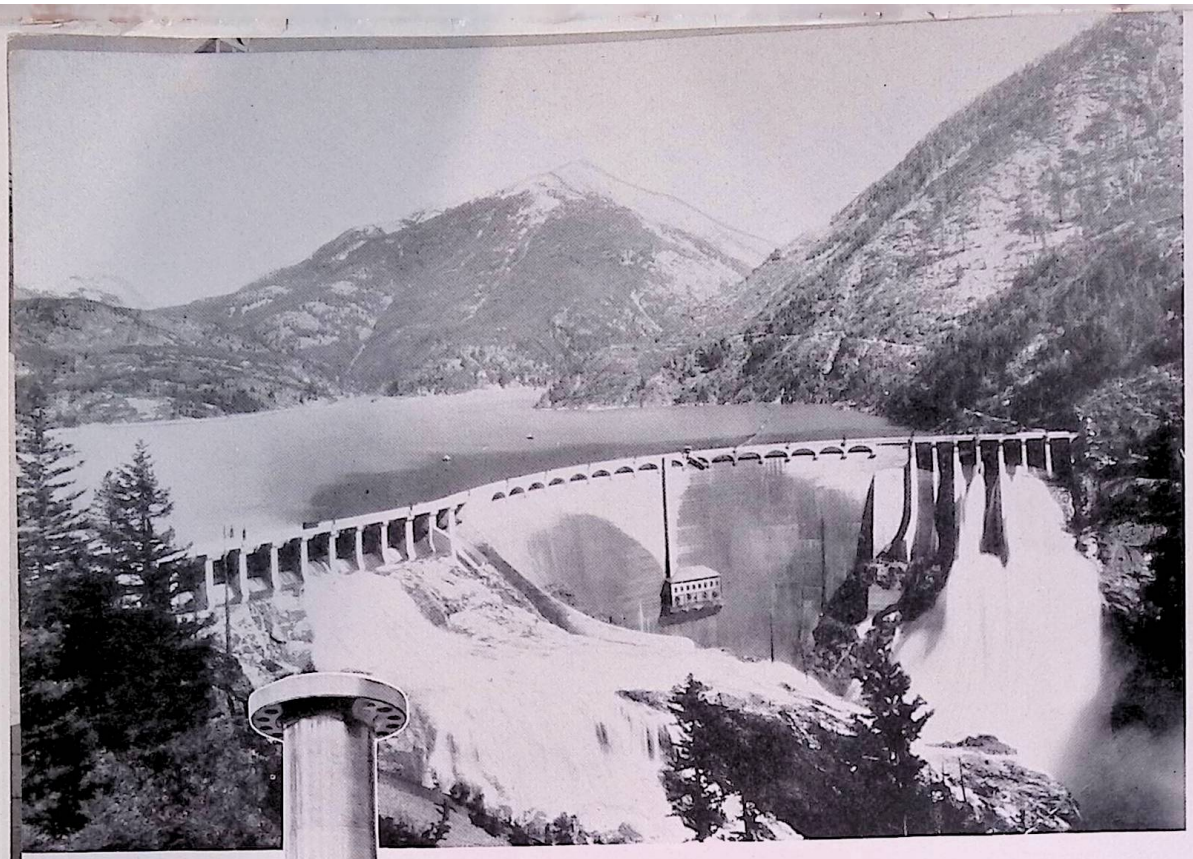
● Right: 19-foot inlet diameter plate steel spiral case of 1⅜ inches maximum plate thickness.



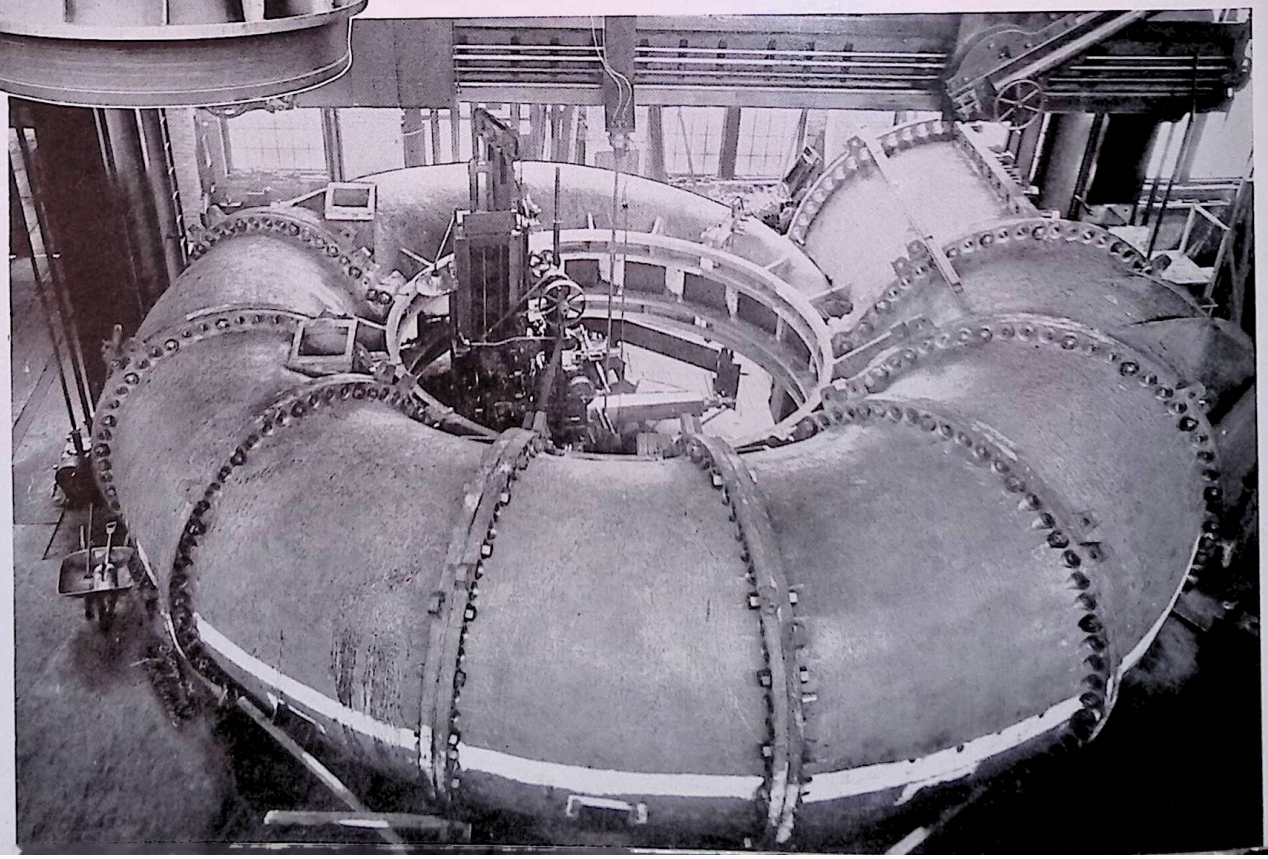


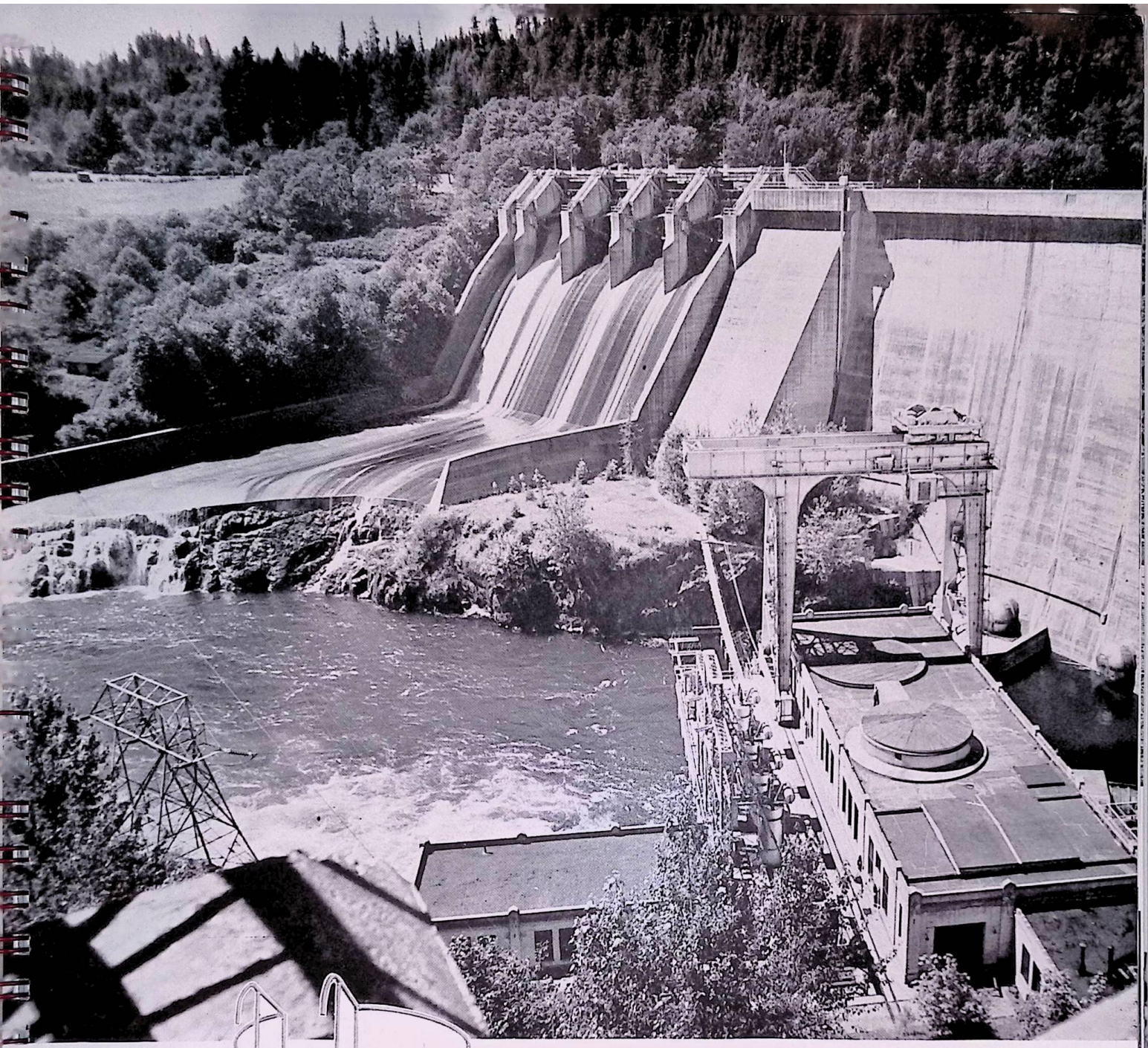
● Douglas Dam on the French Broad River is another T.V.A. project. The turbines are duplicates of Cherokee.



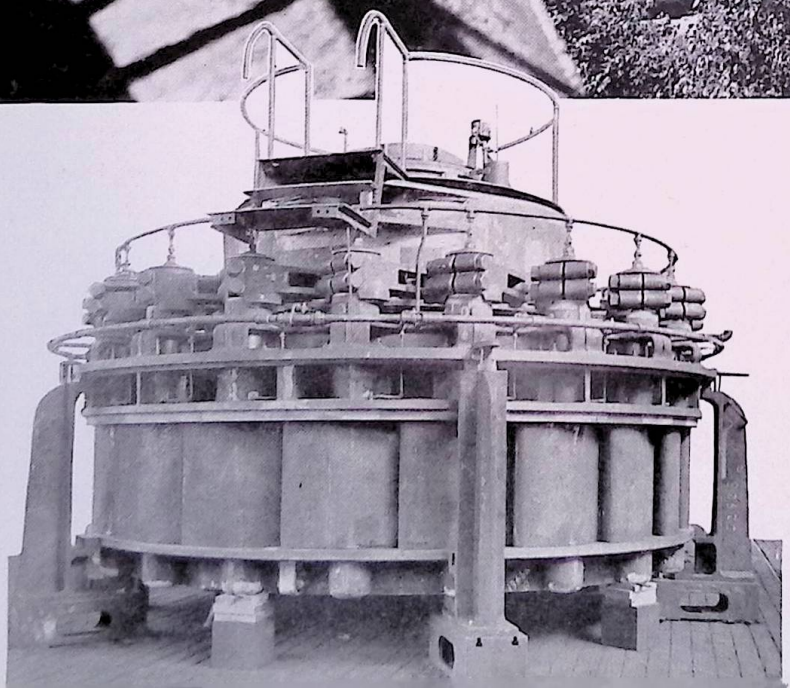


● City of Seattle, Diablo Dam, Skagit River, Washington. Two 90,700 H.P. turbines under 327 feet head. Turbine runner weighing 56,800 pounds with shaft 32¼ inches in diameter, shown at left. Below is view of cast steel spiral case with 138-inch inlet diameter, weighing 390,000 pounds.

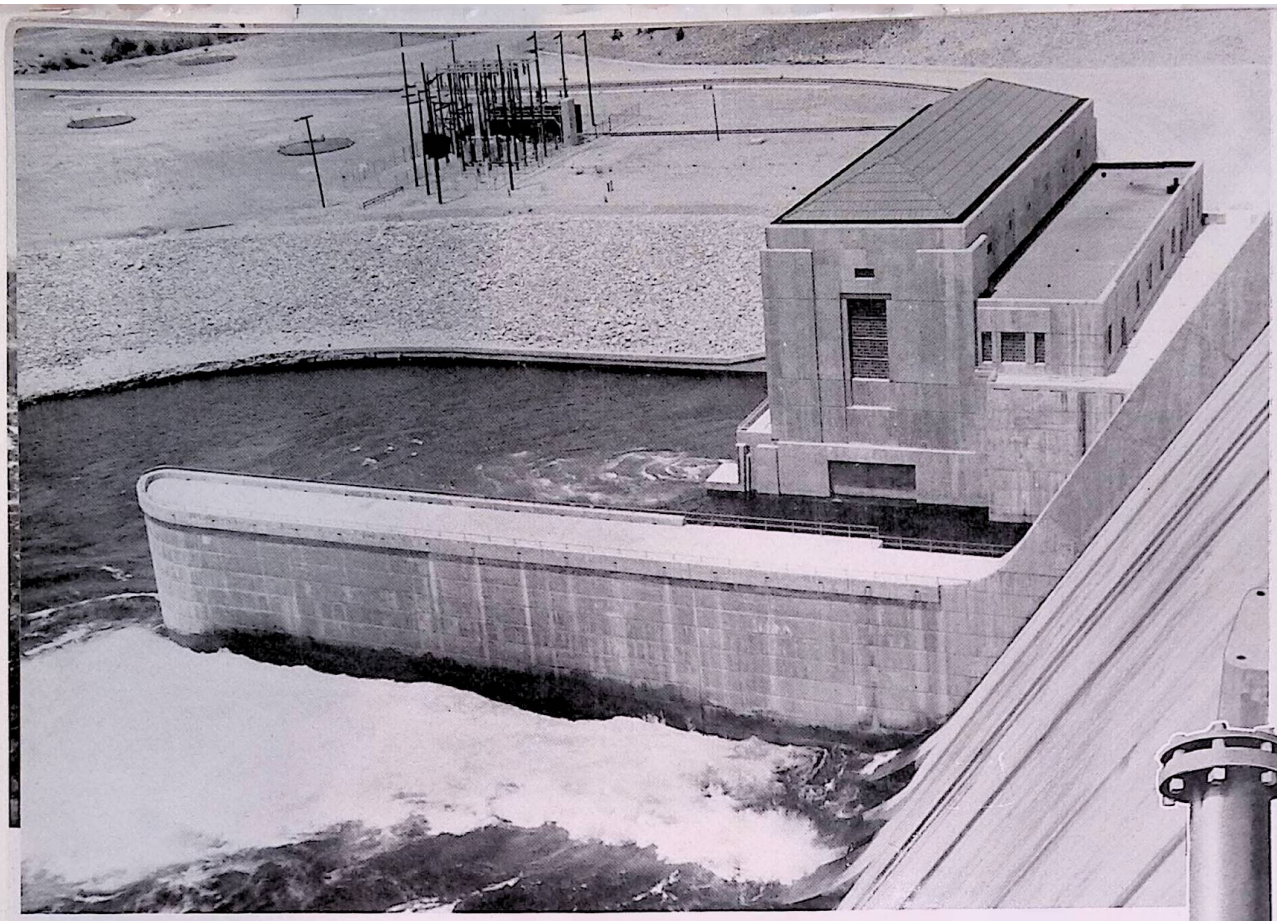




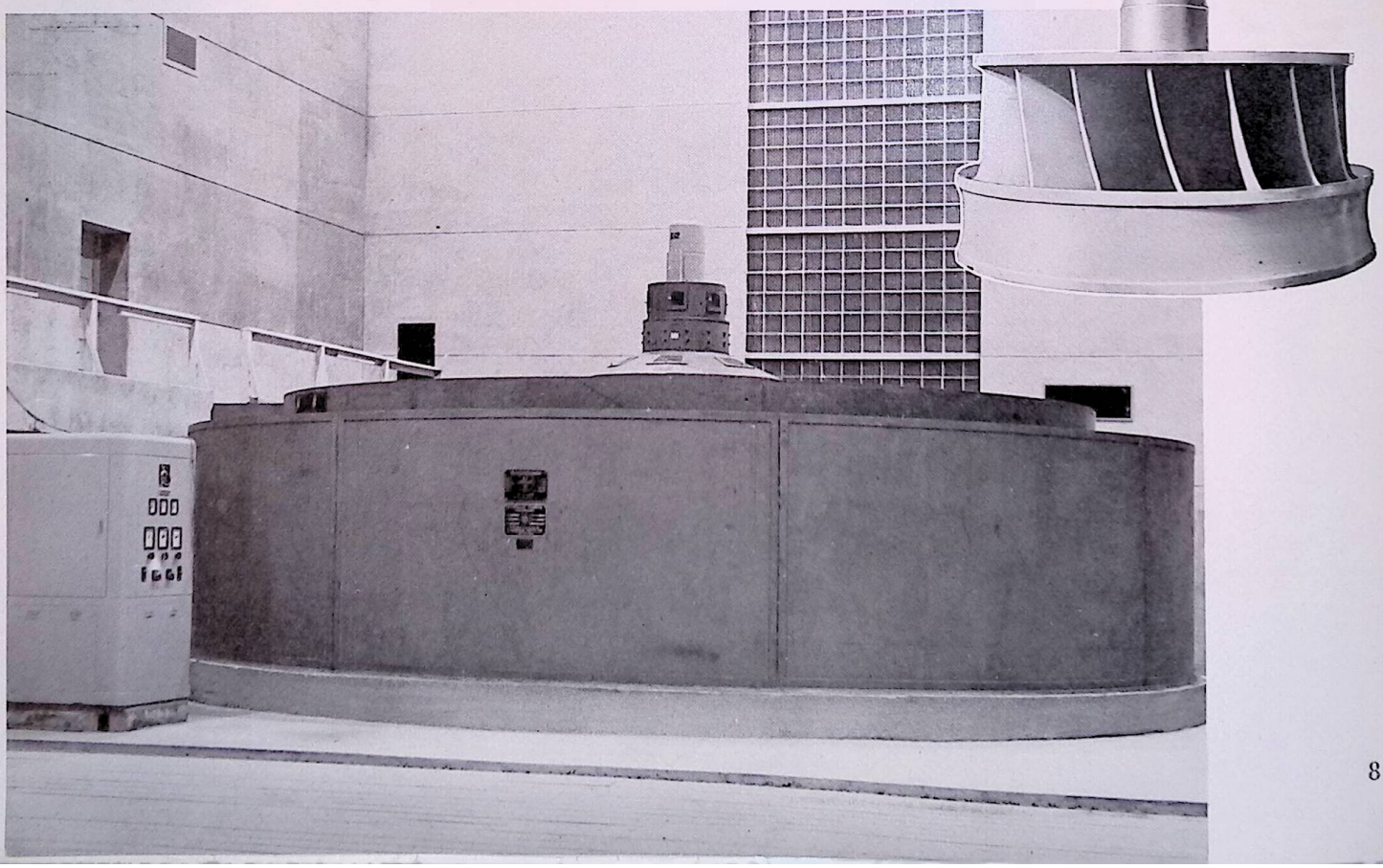
● Merwin Hydroelectric Project of Pacific Power & Light Co., on Lewis River, Washington. Two units are each rated at 55,000 H.P. and operate under 170 feet head.

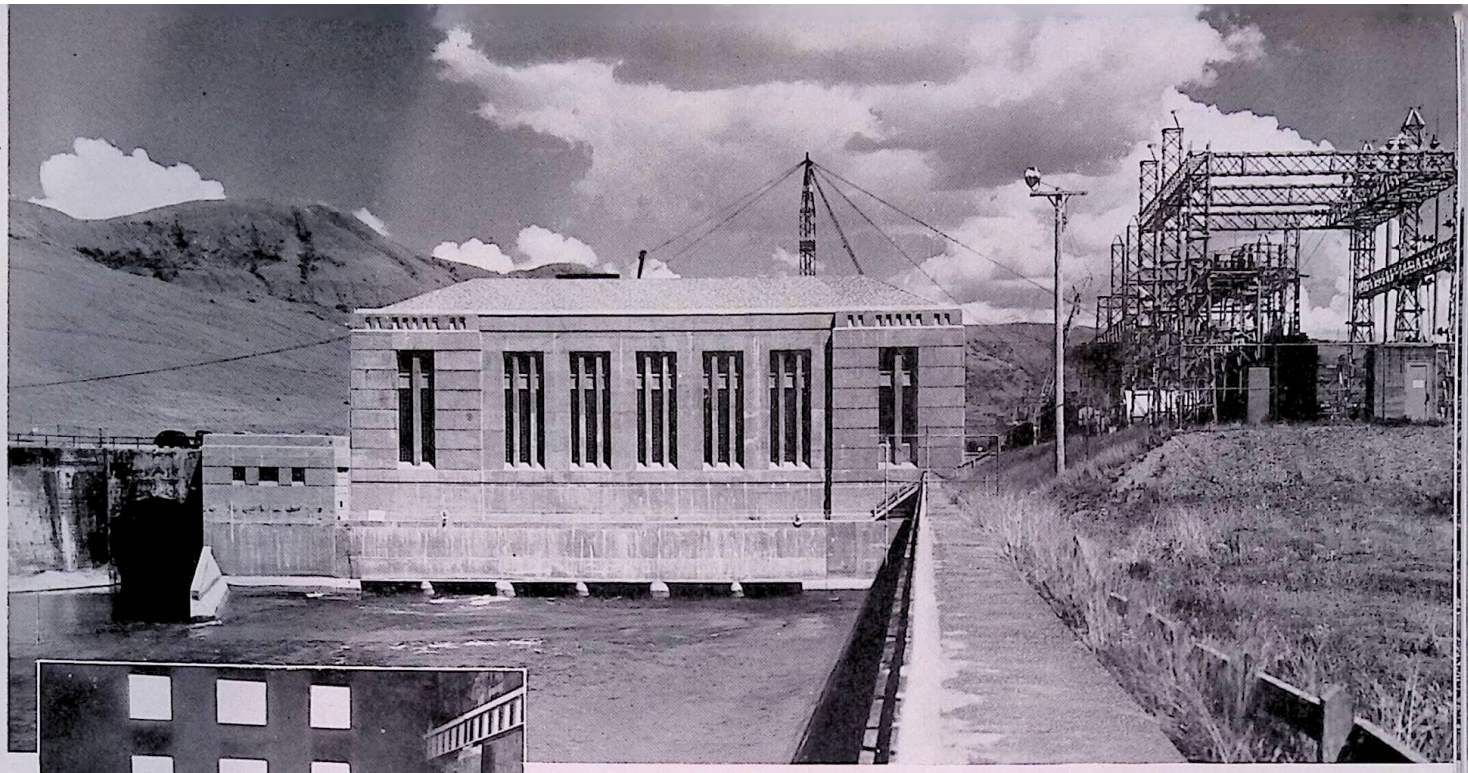


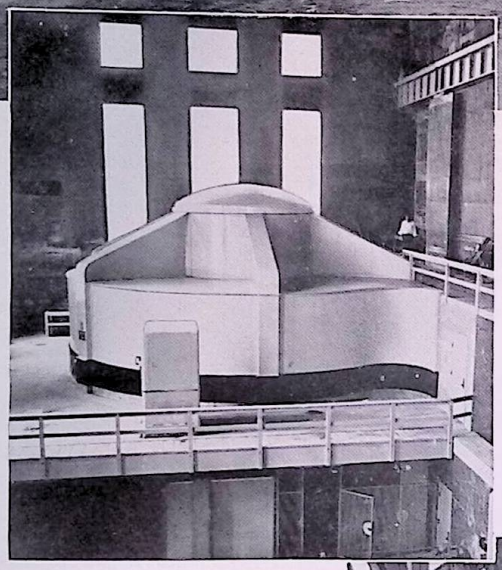
● Shop view of distributor assembly.



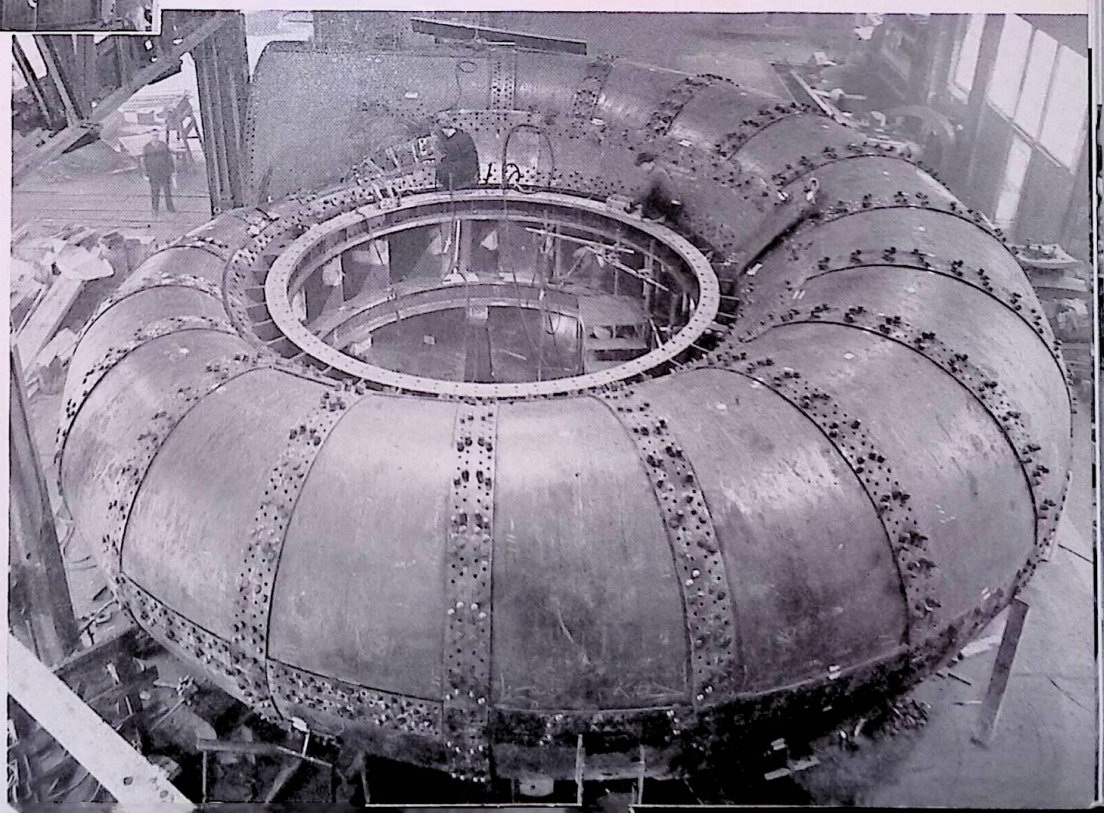
● U.S. Engineers, Norfork Dam, North Fork River, Arkansas. Two 42,000 H.P. turbines operate under 160 feet normal head. Maximum head is 202 feet.



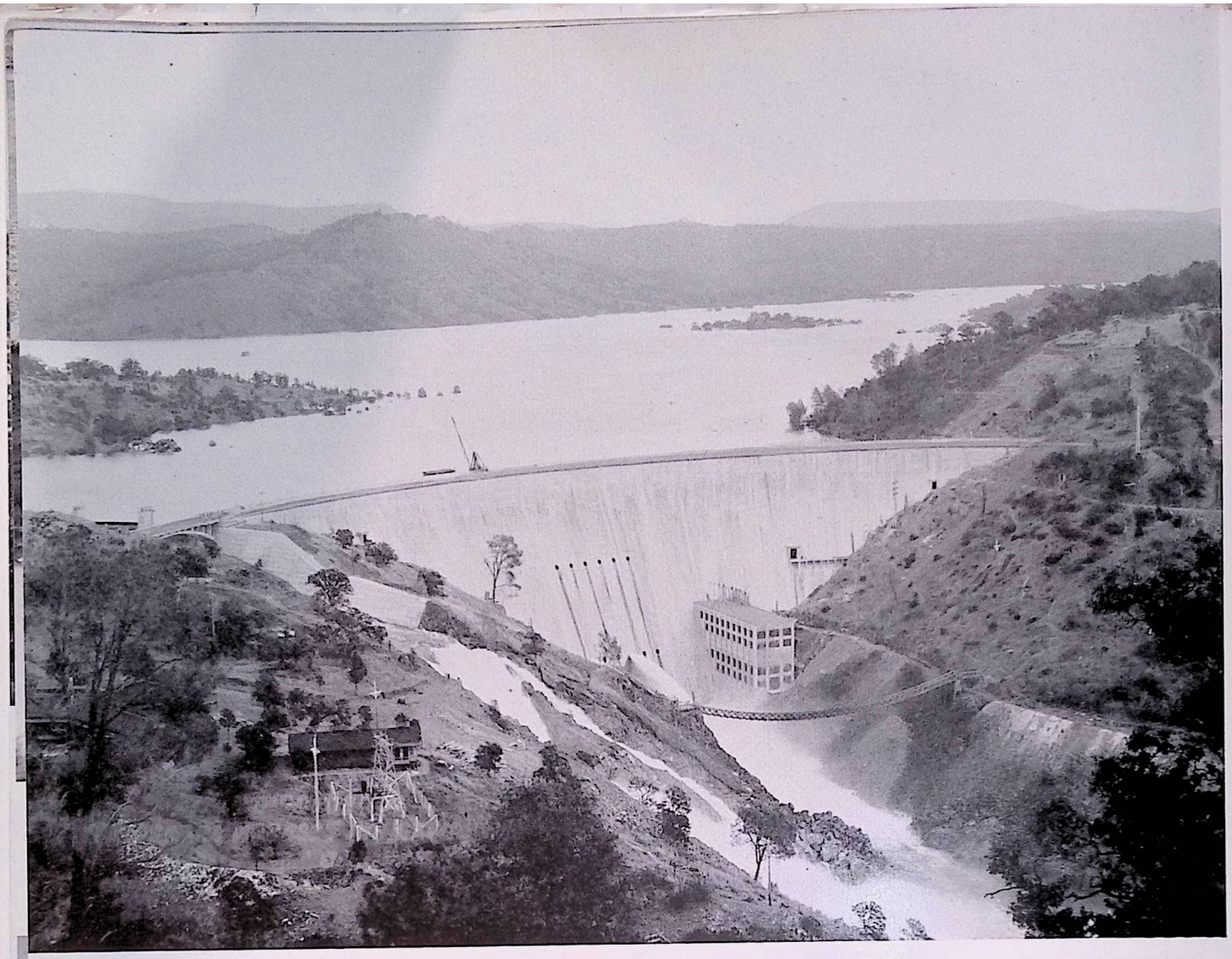


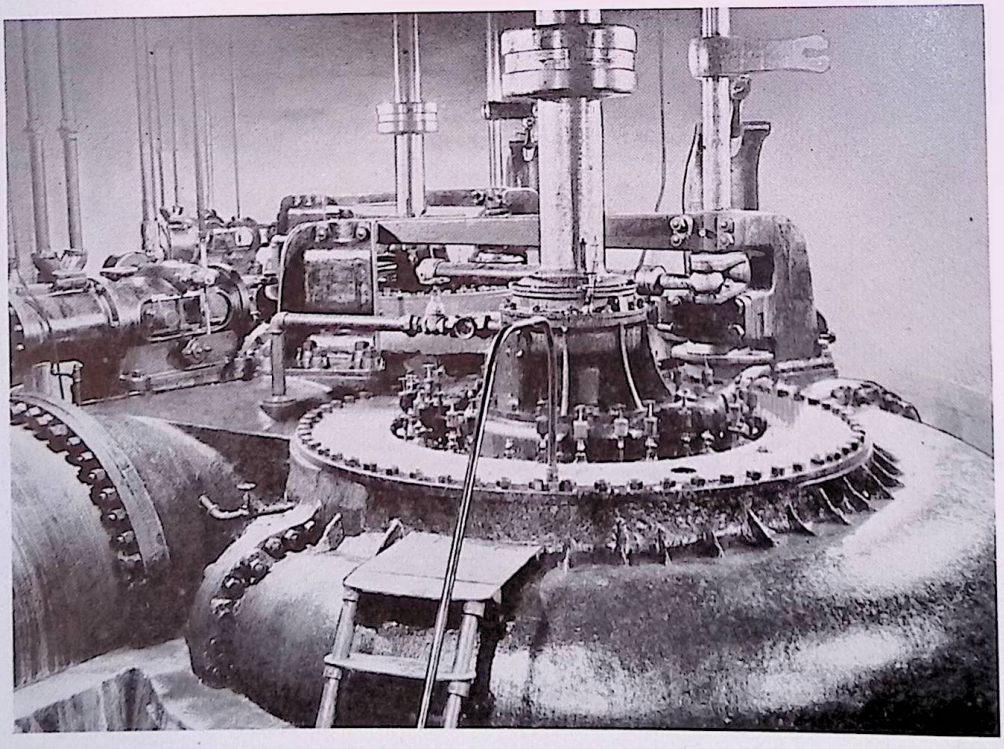


● U.S. Engineers, Fort Peck Power House, Missouri River, Montana. Two different size units are installed, one rated at 50,000 H.P. under 170 feet head, and one at 20,000 H.P. under 140 feet. A duplicate of the larger unit has been ordered. The plan is to replace the present smaller unit with the larger one when the regulation of the river has been improved. The head varies from 75 to 216 feet.

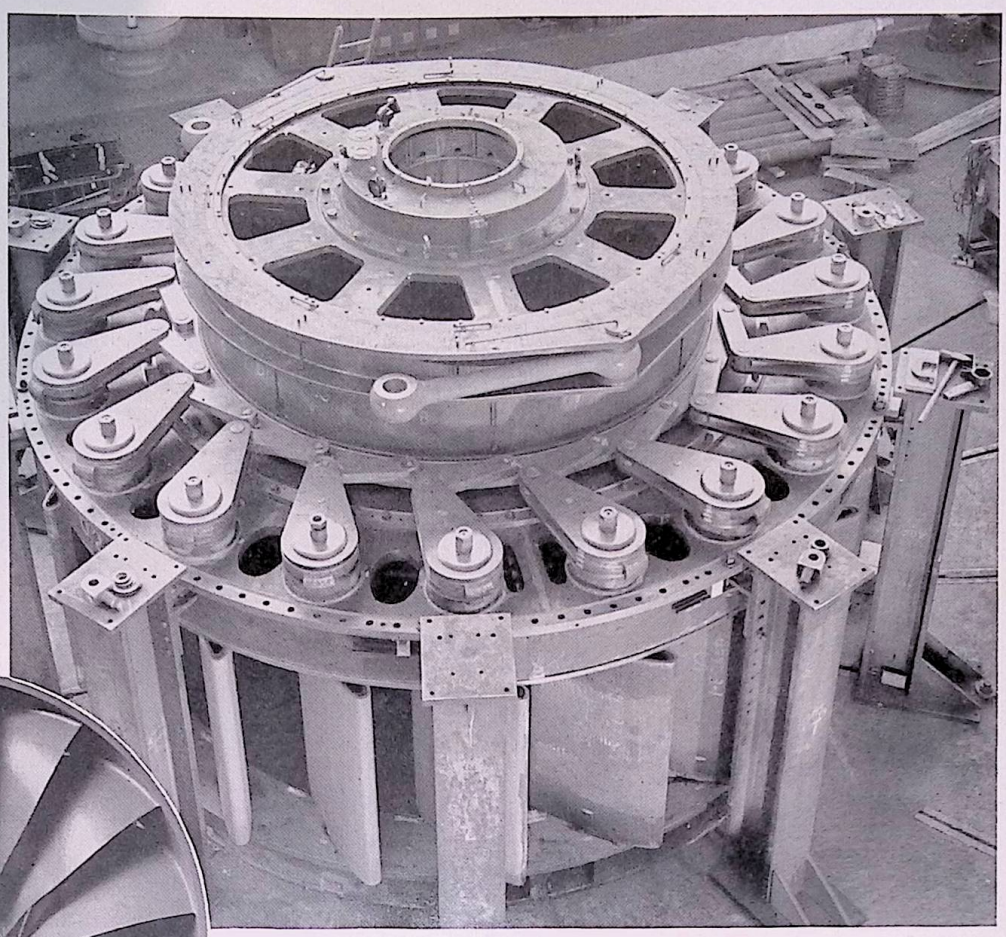


● Plate steel spiral casing for the 50,000 H.P. unit. Note the butt strap construction.

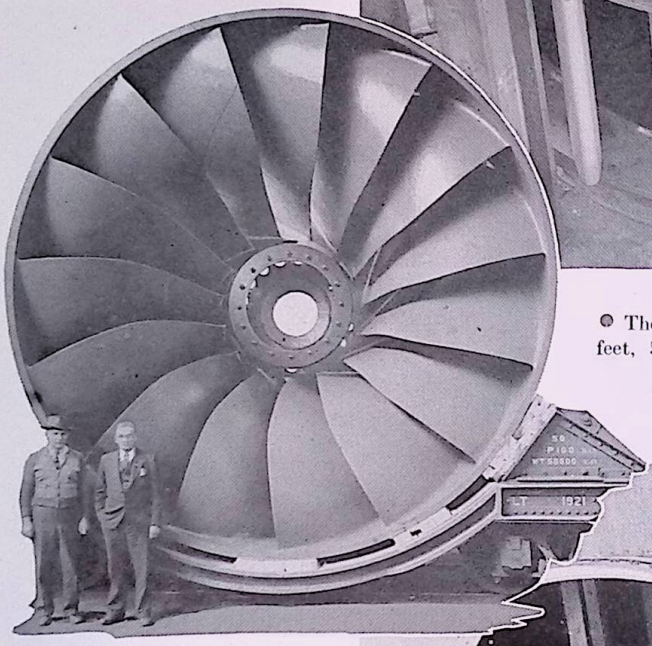




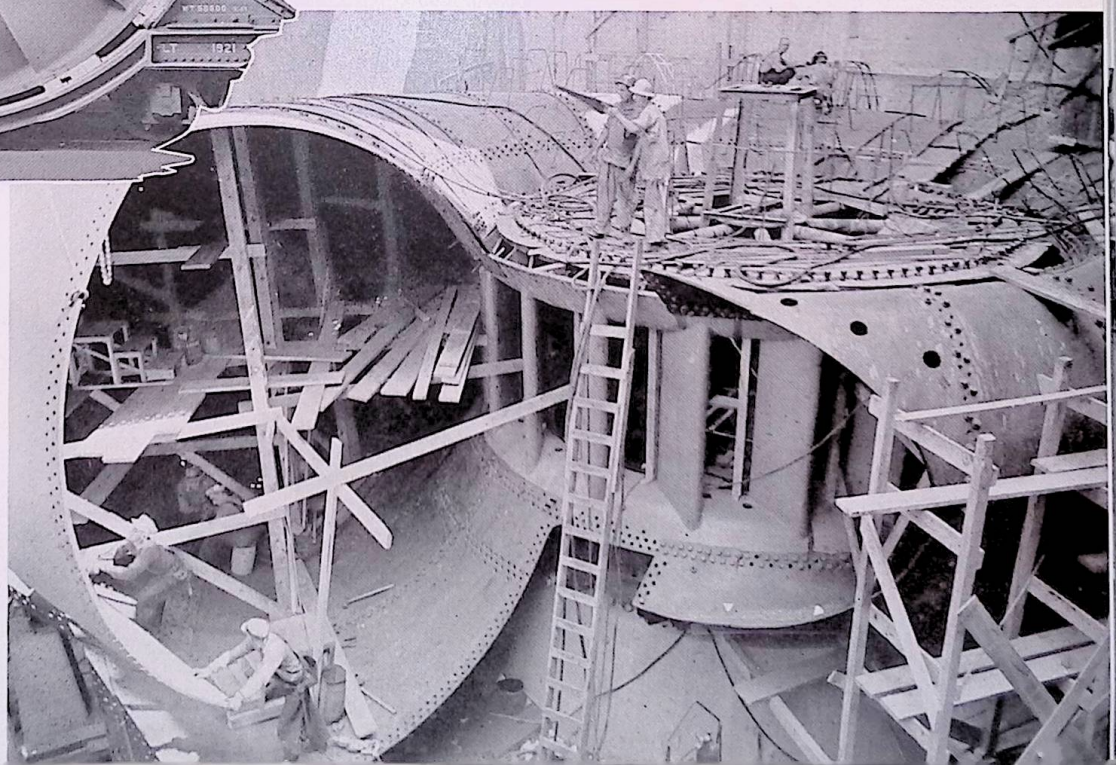
● The Don Pedro Dam of the Turlock and Modesto Irrigation Districts, located on the Tuolumne River near La Grange, California, has five vertical shaft turbines. Three units are each rated at 7200 H.P. under 160 feet head and two at 10,500 H.P. under 180 feet head. All units are set in cast spiral cases, as shown, with each having a 72-inch inlet diameter.



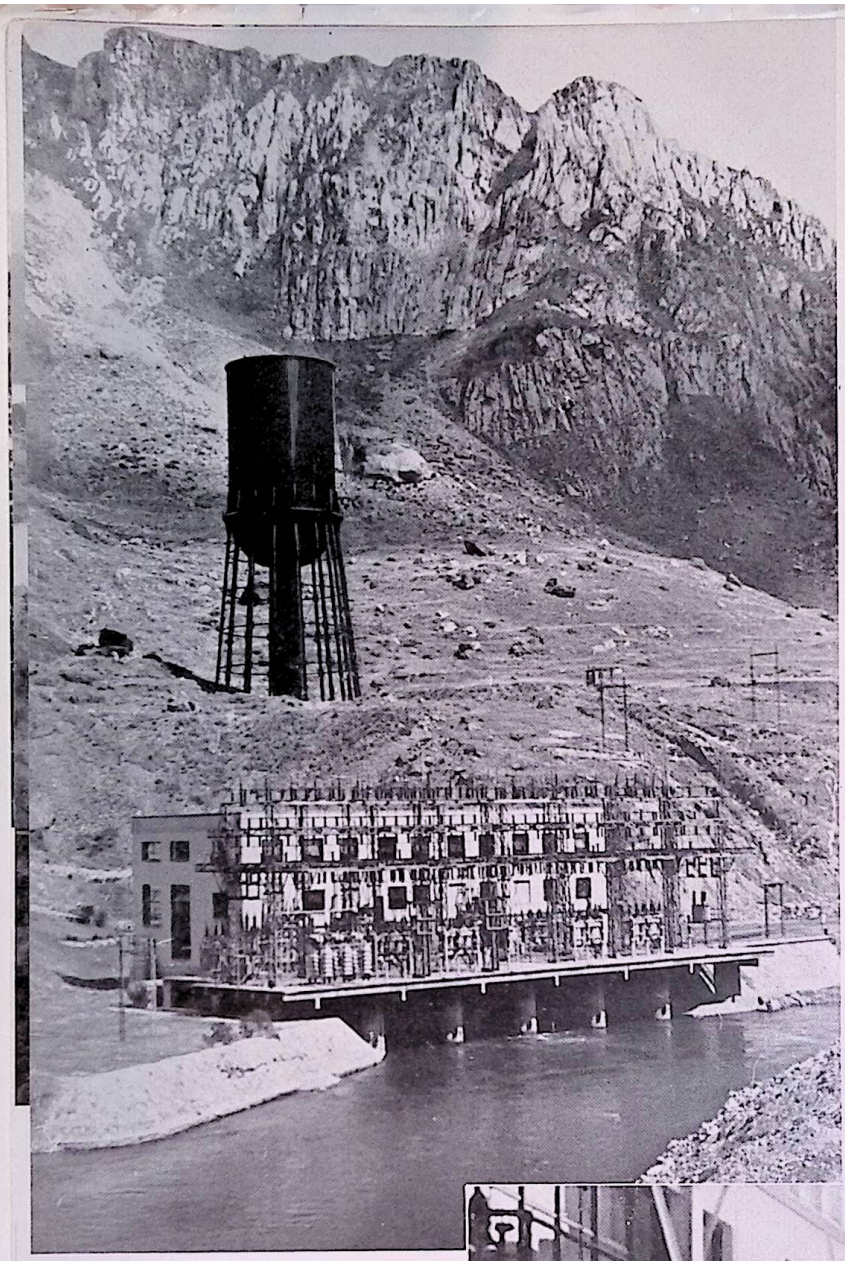
● U.S. Engineers, Denison Dam, Texas. Two units of 56,000 H.P. each, under 102.5 feet head. View of the Distributor assembly. Note shear pin double lever construction of gate arms.



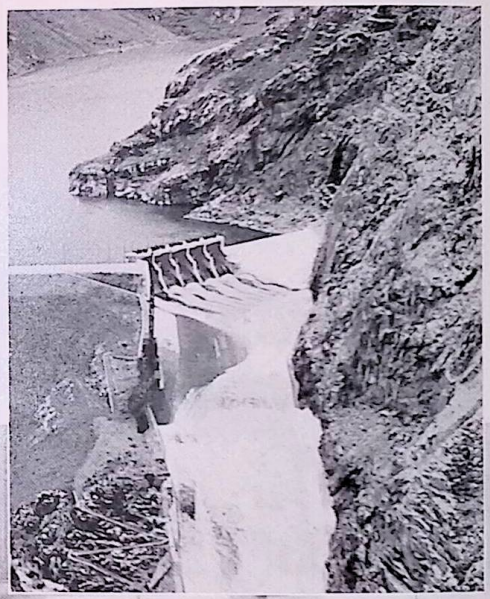
● The 149,000-pound runner, measuring 16 feet, 5½ inches across the finished band.

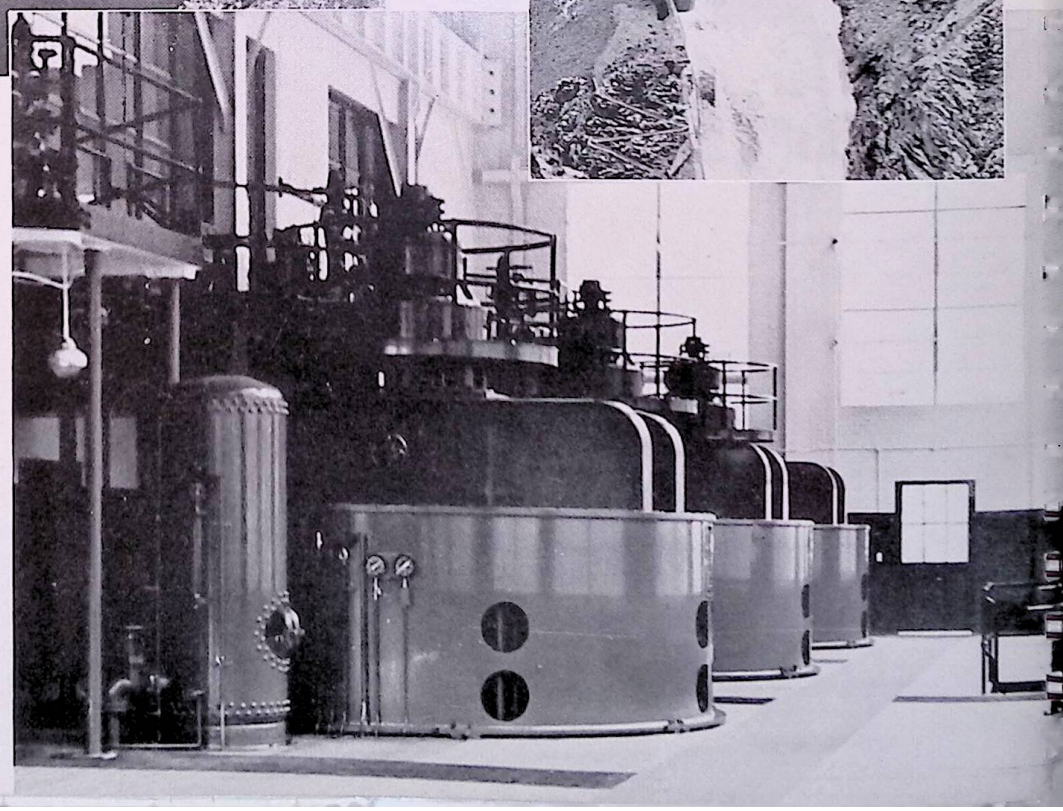


● The field assembly of the 20-foot inlet diameter spiral casing.

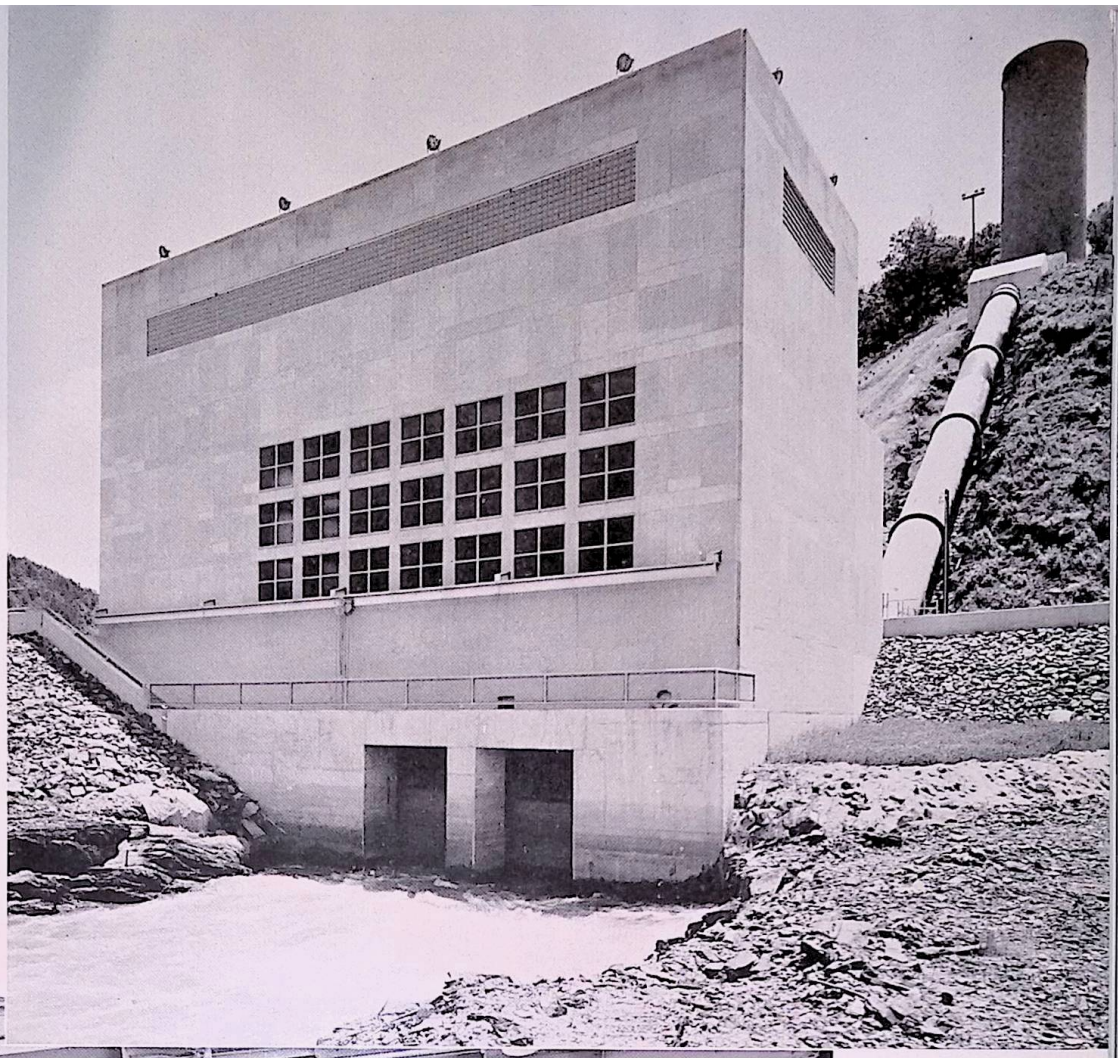


● Malpaso Plant of the Cerro de Pasco Copper Corporation, near Oroya, Peru. Power house is located 12,500 feet above sea level.

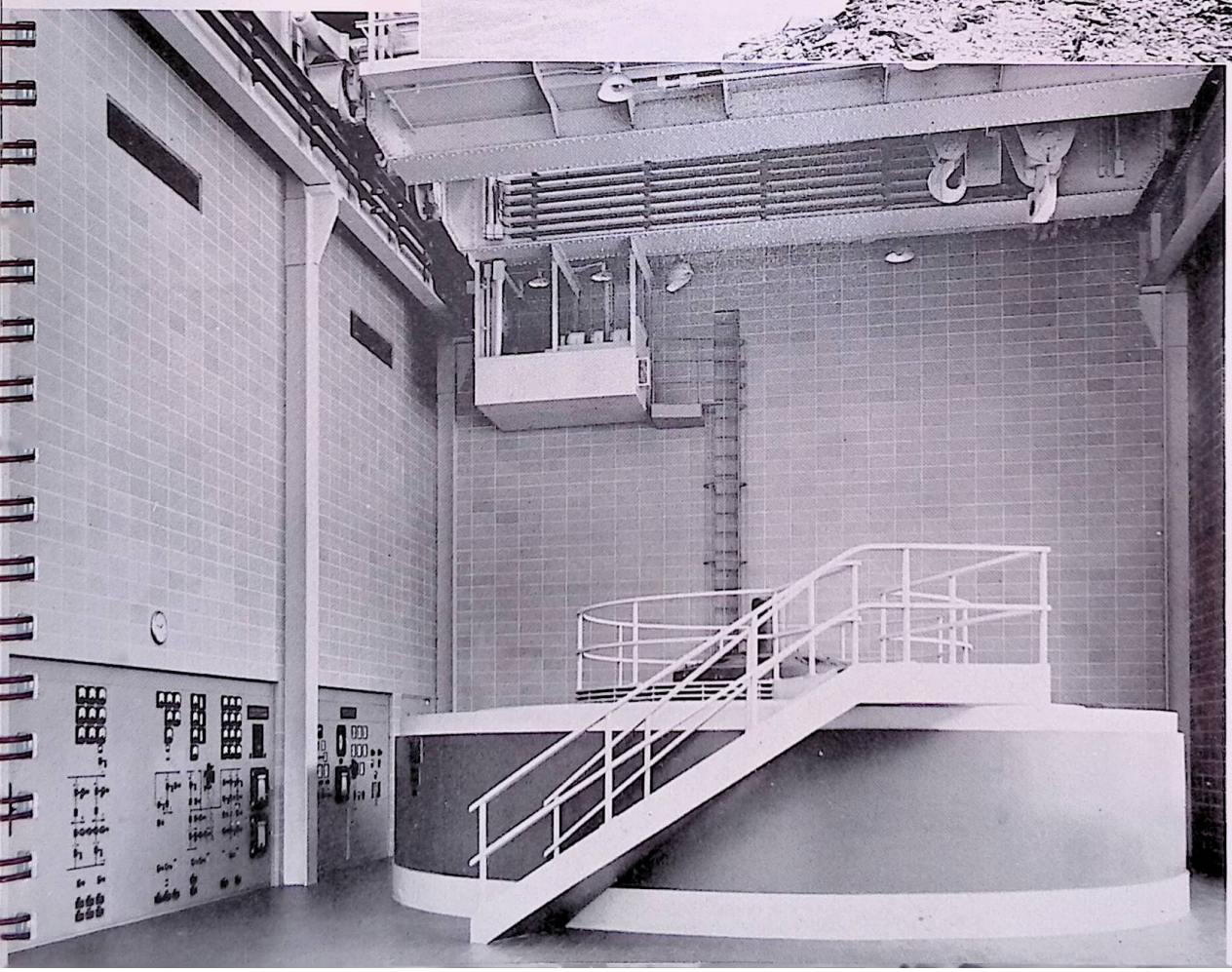




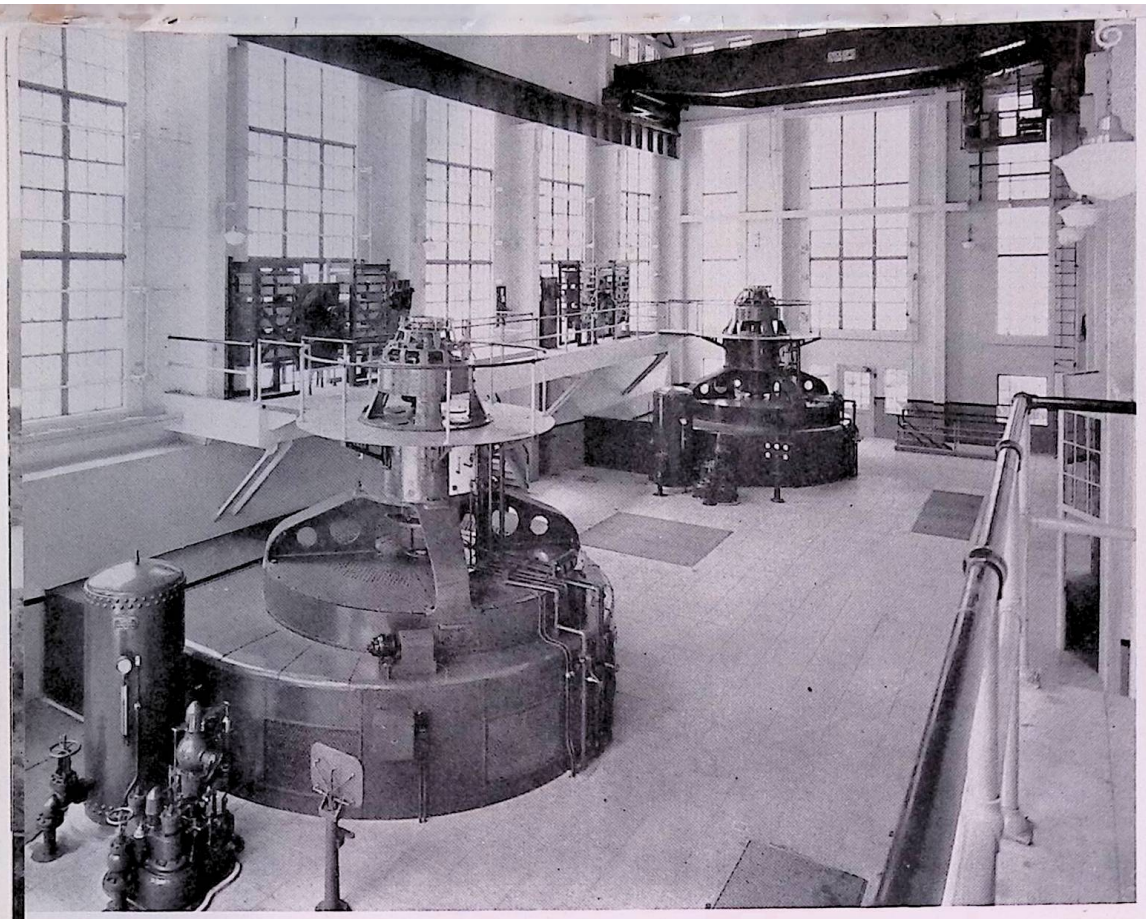
● Three 17,500 H.P. Smith-Francis turbines operating under 240 feet head drive these vertical generators.



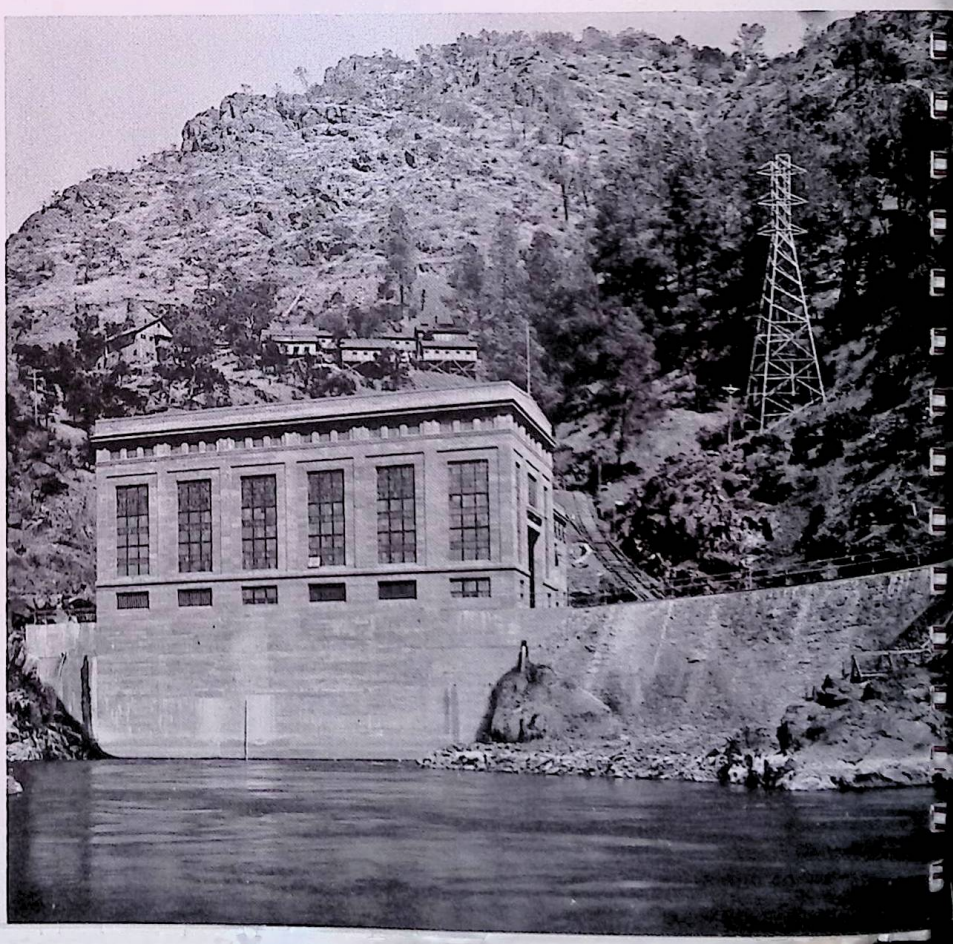
● Ocoee No. 3 Plant of the T.V.A. on the Ocoee River, Tennessee. The single Smith-Francis turbine installed develops 33,500 H.P. under heads ranging from 250 to 300 feet.



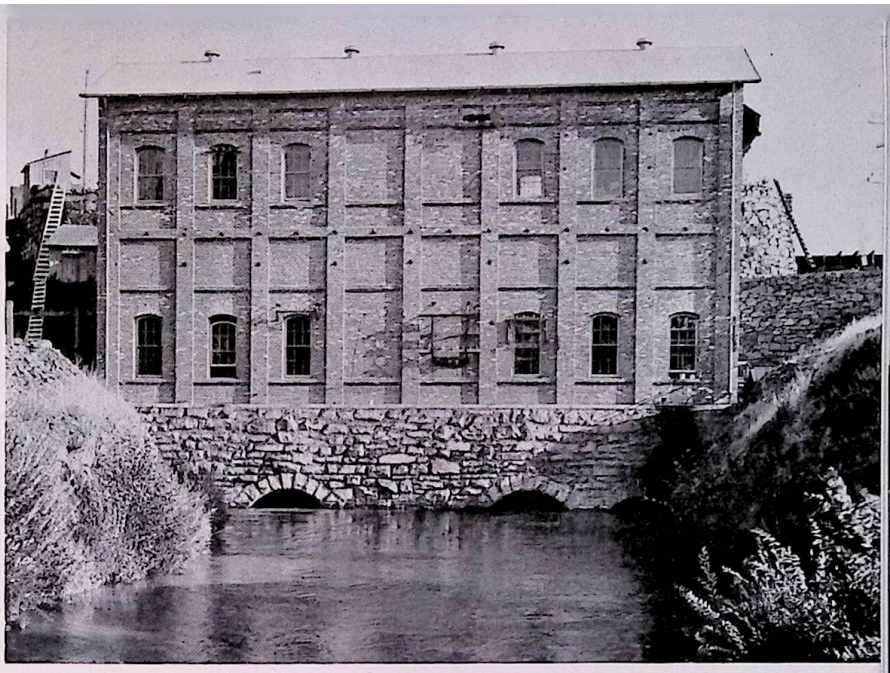
● This automatic station is remote-controlled and is entirely unattended.



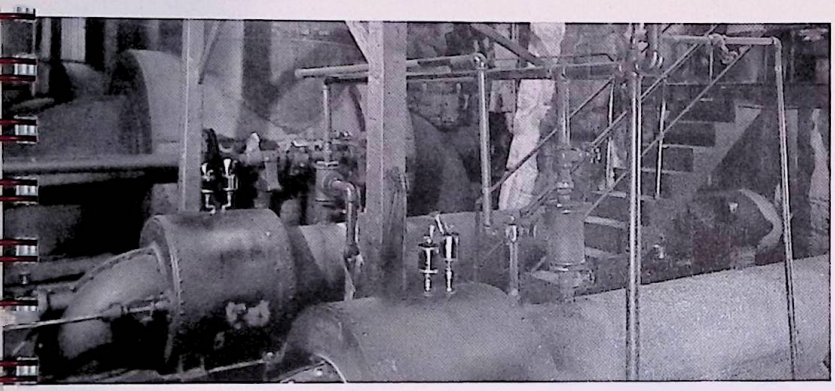
● The Melones Plant of the Pacific Power & Light Company on the Stanislaus River, California. The actuator governors were built by S. Morgan Smith Company.



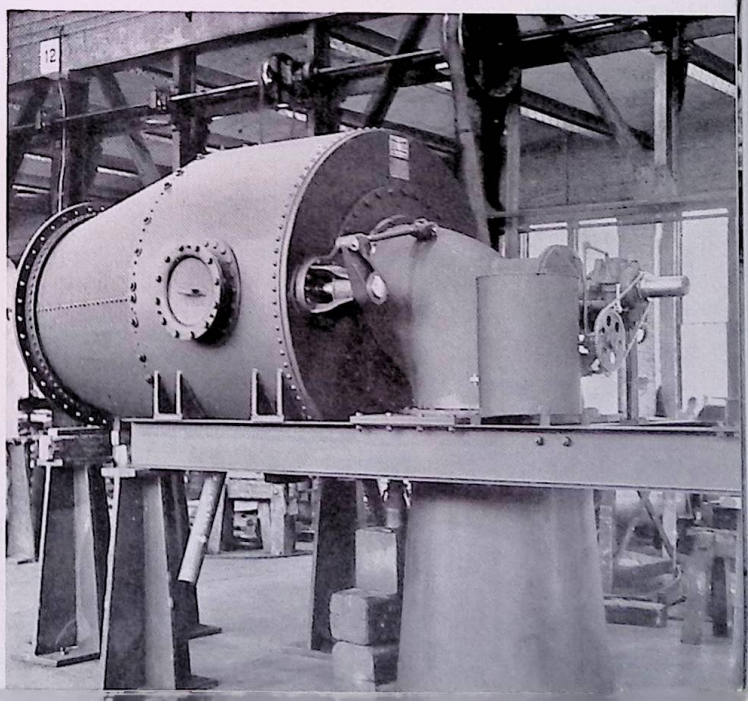
● Exterior of the power house in which two 17,690 H.P. Smith-Francis turbines operate under heads varying from 125 to 225 feet.



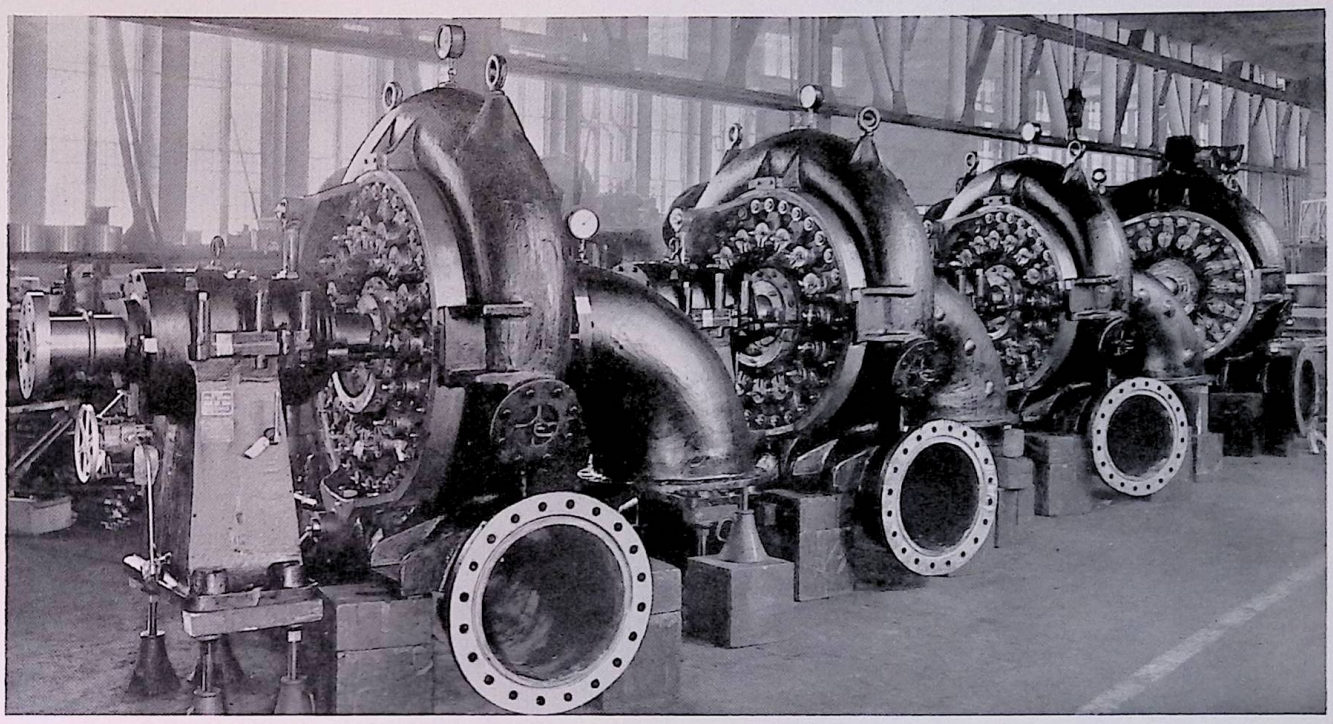
● Folsum Plant of the Sacramento Electric, Gas and Railway Co., in California, in which Francis turbines were installed in 1895. It performed the unprecedented service of transmitting electric energy at 11,000 volts over a 22-mile transmission line to Sacramento for its street railway.



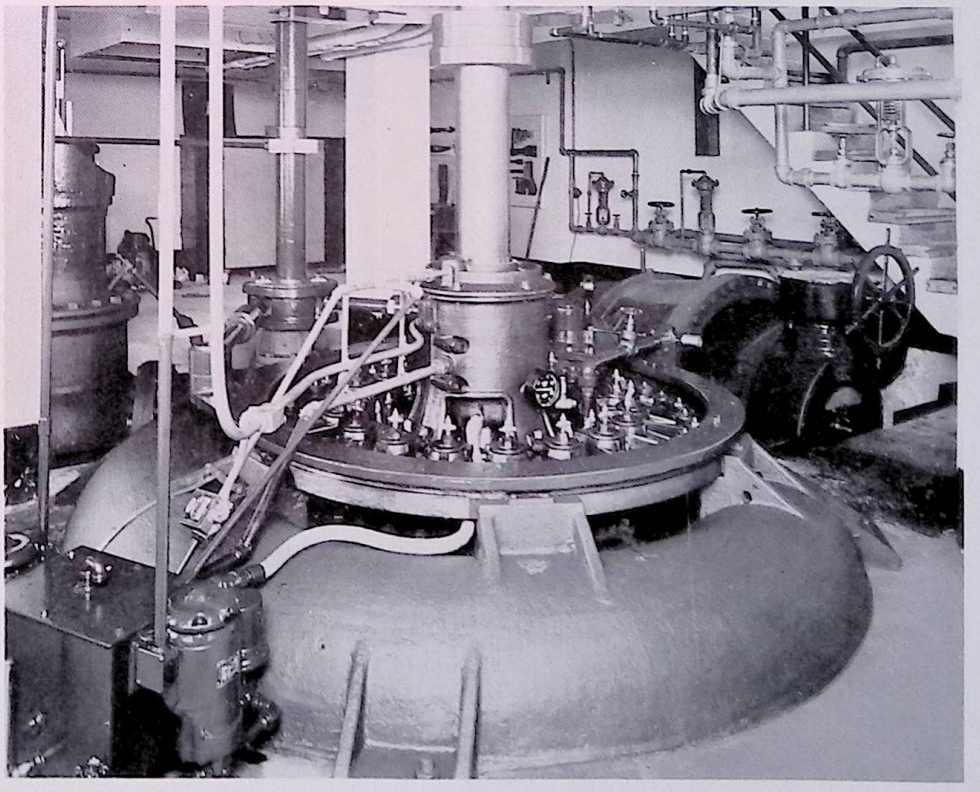
● Four pairs of horizontal cylinder gate Smith turbines under 55 feet head of the size shown in background at the left were connected to 750 K.W. horizontal generators. The original units are still in regular operation.



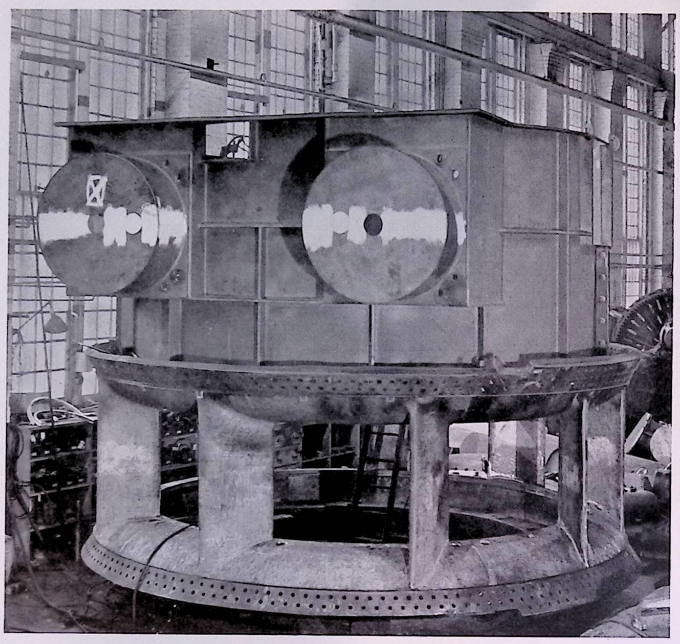
● A small horizontal Francis unit in plate steel end supply case built for W. R. Grace & Company, Chile for Caja de Seguro Oblegatorio. It delivers 230 H. P. at 600 R.P.M. under 36 feet head.



● Four small horizontal spiral case units purchased by the National Resources Commission of China.

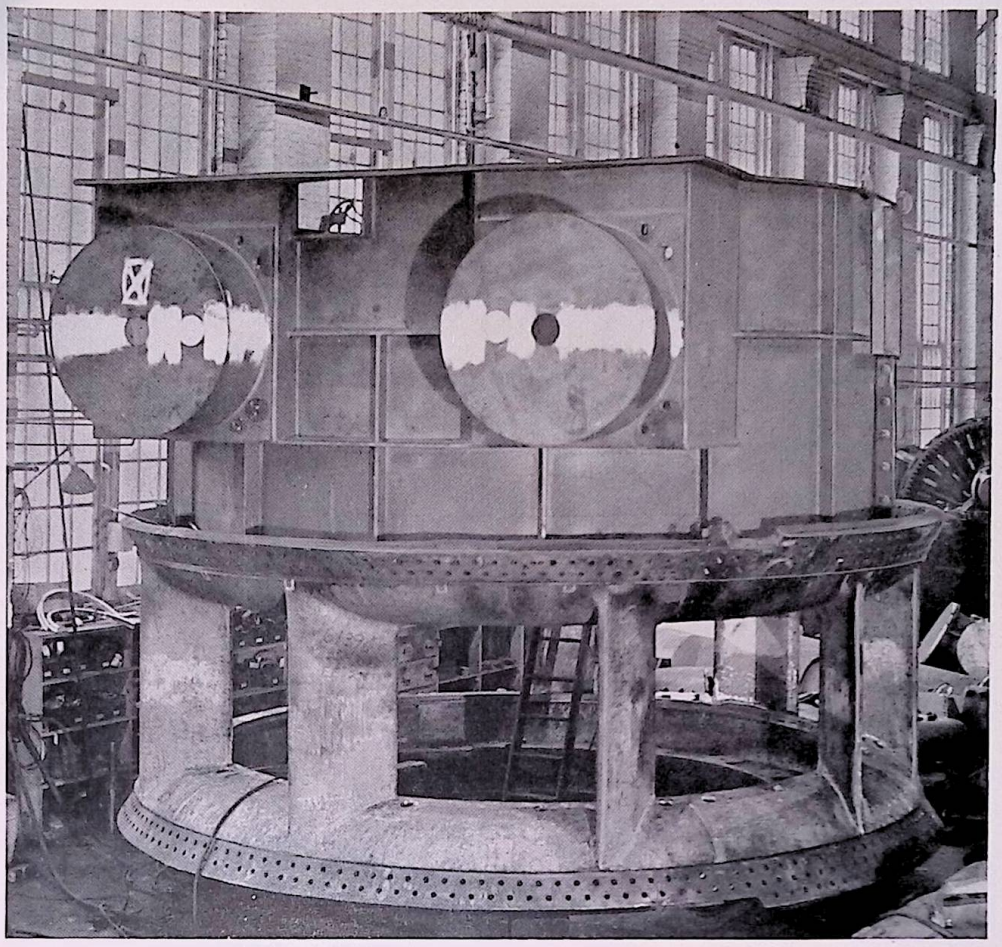


● Roaring River Development of Jamaica Public Service Co., Ltd., Jamaica, B.W.I. This 5700 H.P. vertical Smith-Francis turbine has a 30-inch inlet diameter cast steel spiral case with a concrete elbow type draft tube. Head 520 feet, speed 800 R.P.M. The 30-inch conical plug valve installed at the turbine inlet has a full circular opening which eliminates turbulence and reduces head loss. Note the relief valve to the far left.



● Stay ring and pit liner of Dale Hollow Unit No. 1, U.S. Engineers. This 25,000 H.P. turbine operates under 140 feet head on the Obey River in northern Tennessee.

● Entrance to 12-foot, 6-inch inlet diameter plate steel spiral case.



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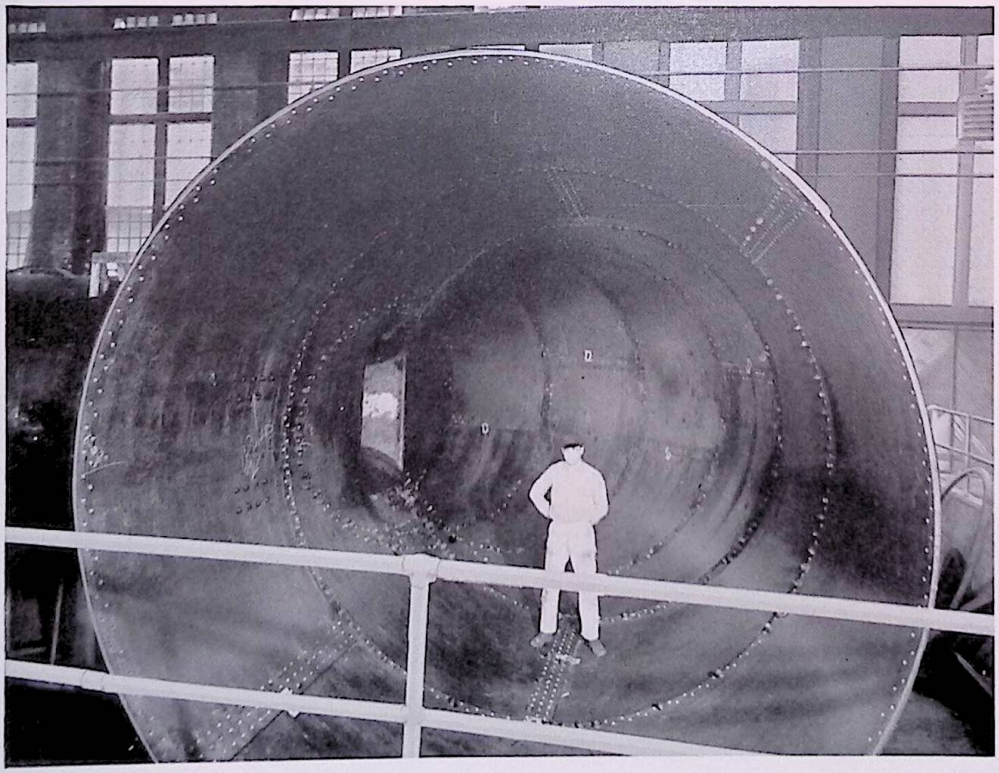
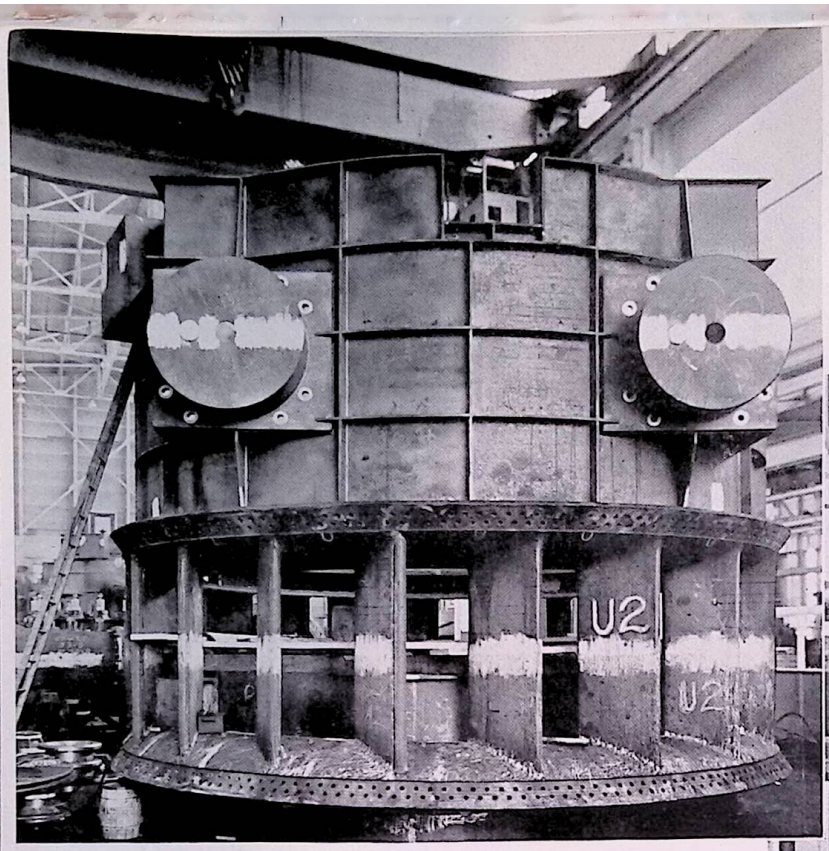
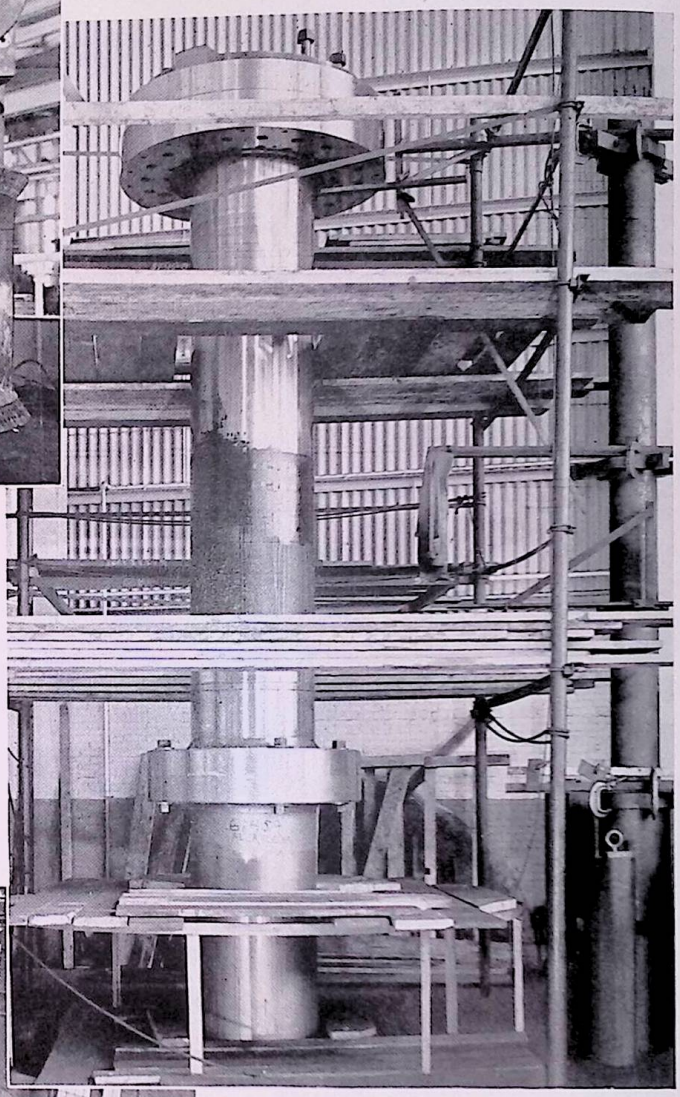


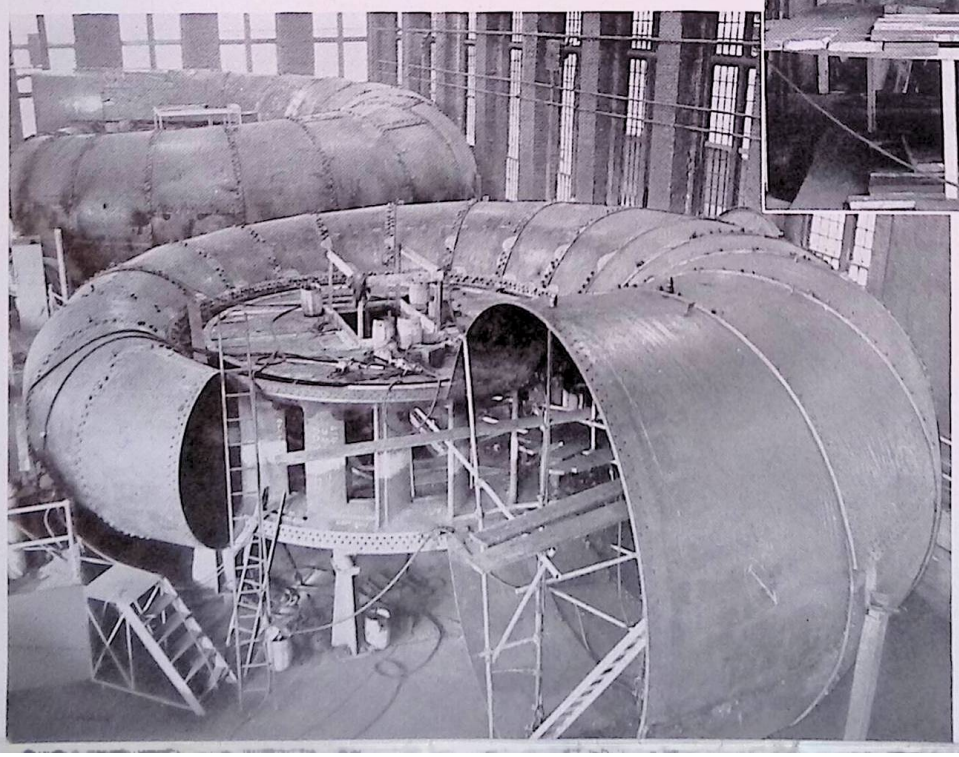
● Entrance to 12-foot, 6-inch inlet diameter plate steel spiral case.



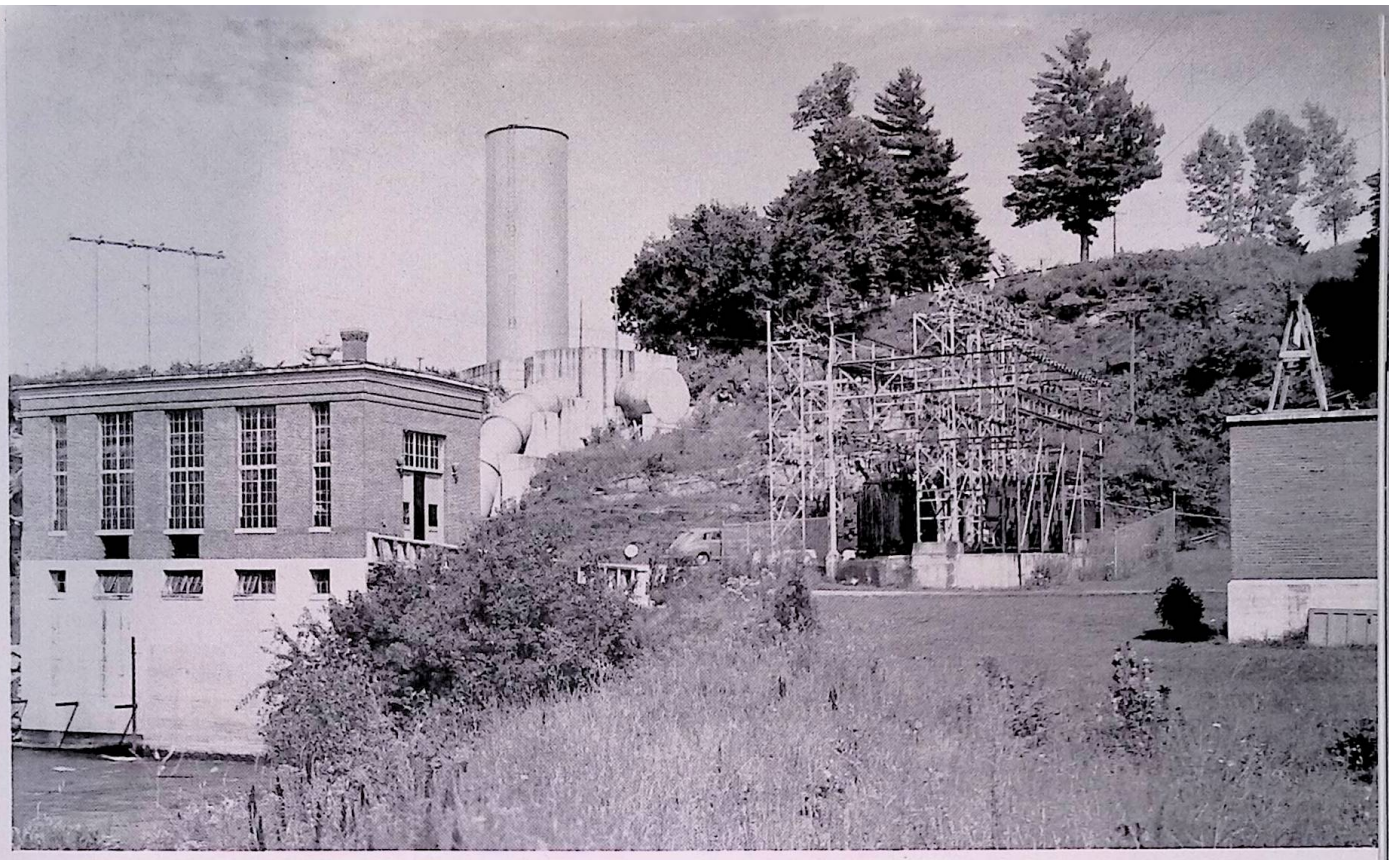
● Shop assembly of stay ring and pit liner for one of the two 50,000 H.P. turbines built for U.S. Engineers for installation at Allatoona Dam on the Etawo River, Georgia. Head 106.7 to 166.7 feet.

● View of the Turbine and generator shafts being aligned in the Smith shops.

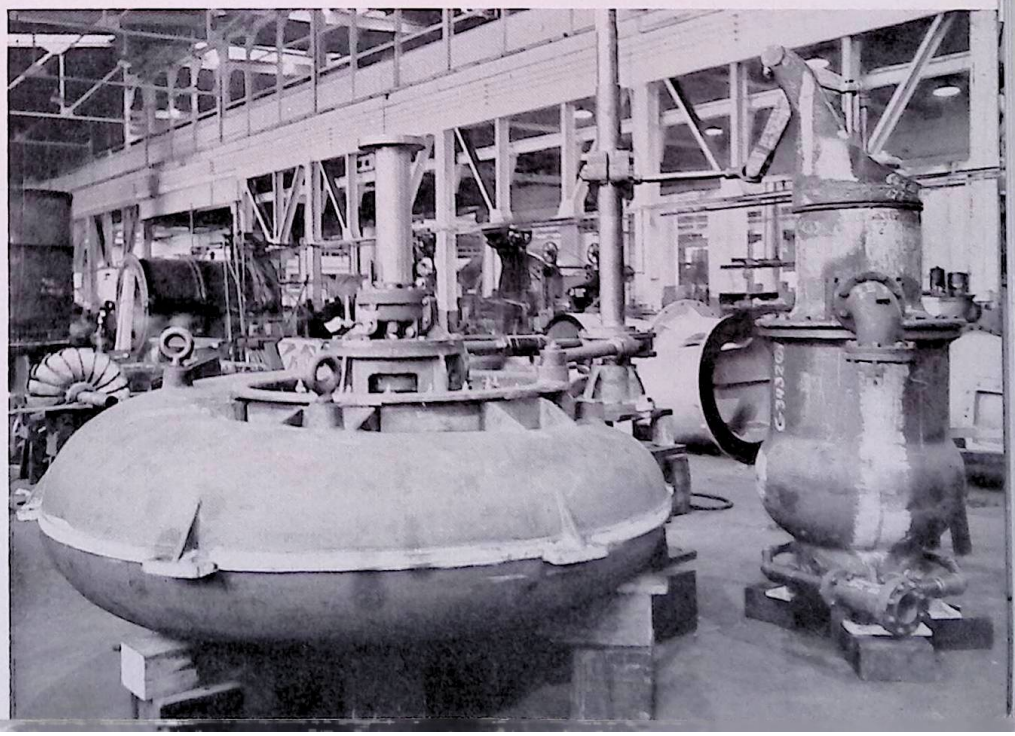




● Note: Right and left hand spiral cases on shop assembly floor.



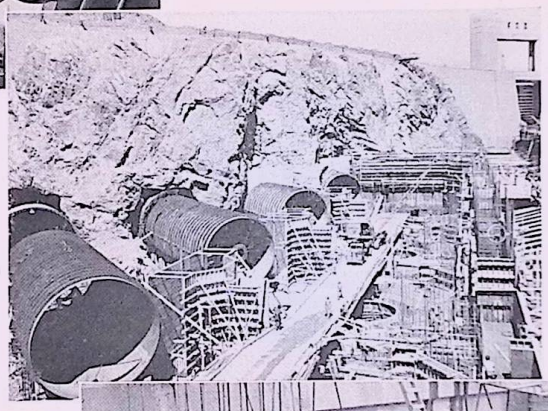
● In the above modern plant of the Public Electric Light Co., Milton, Vermont, two 4500 H.P. Smith-Francis units operate under 95 feet head.



● Shop assembly of vertical 1680 H.P. turbine in 36-inch inlet diameter cast iron spiral case with 20-inch relief valve. The unit was installed under 145 feet head by the Commonwealth of Massachusetts for use at Windsor Dam.

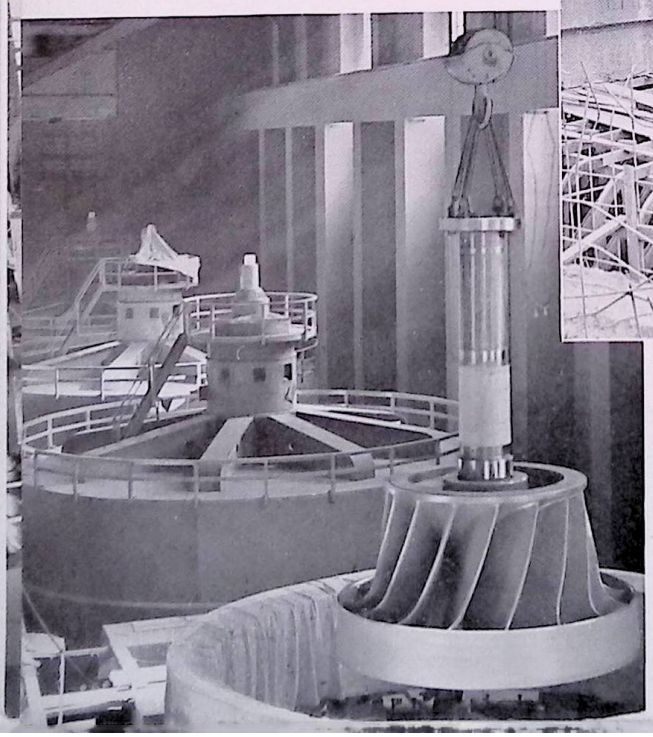
● Parker Dam, a U.S. Bureau of Reclamation Project on the Colorado River, has four 40,000 H.P. units operating under 80 feet head. This dam also serves as a supply basin for the Intake Pumping Station of the 260-mile aqueduct of the Metropolitan Water District of Southern California, where three 64-inch Smith Rotovalves are installed for pump check service.

● The 60-ton turbine runner.



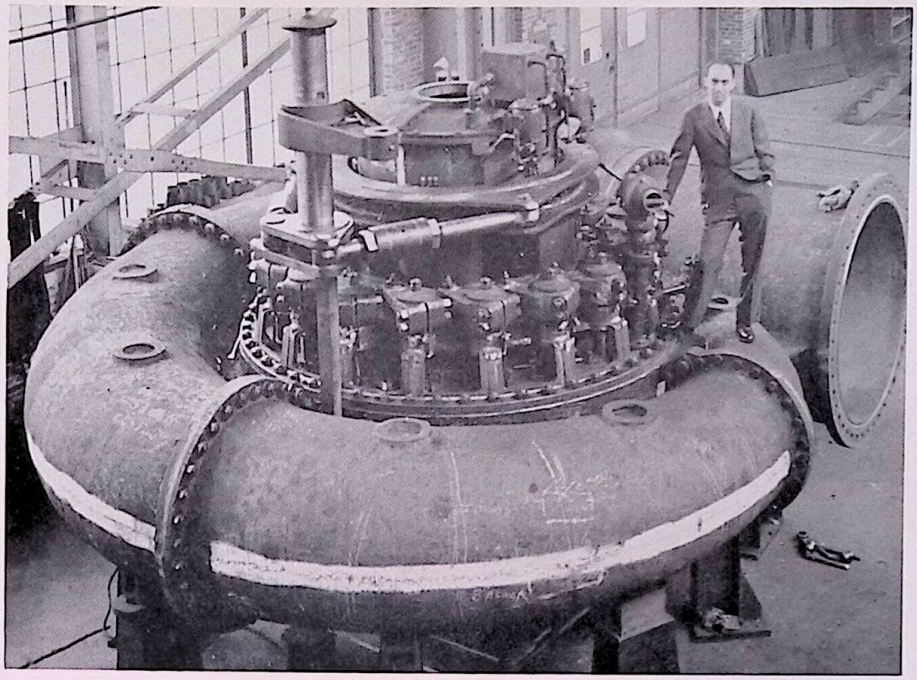
● Penstocks leading to power house.

● Form work for concrete elbow draft tubes.

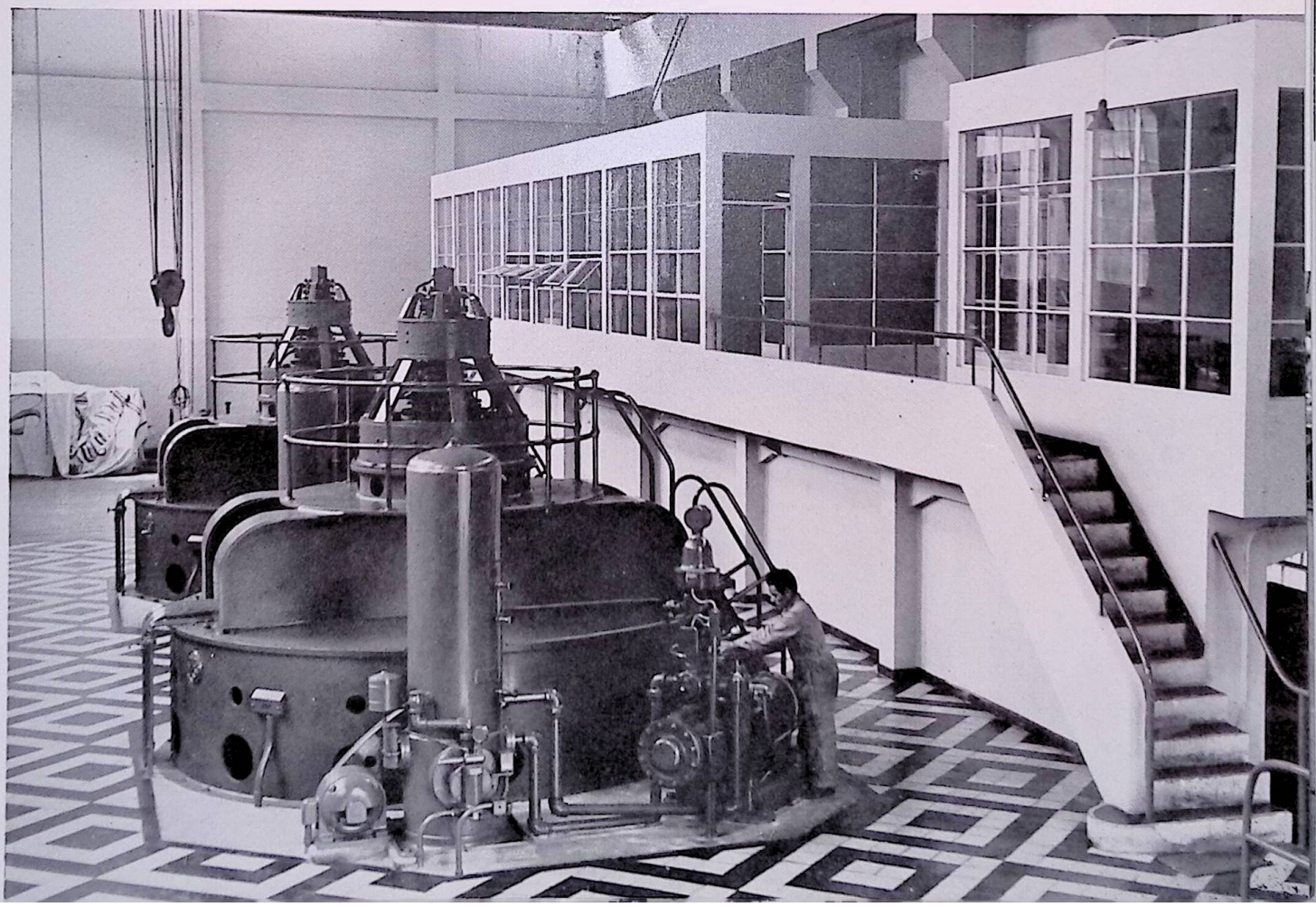


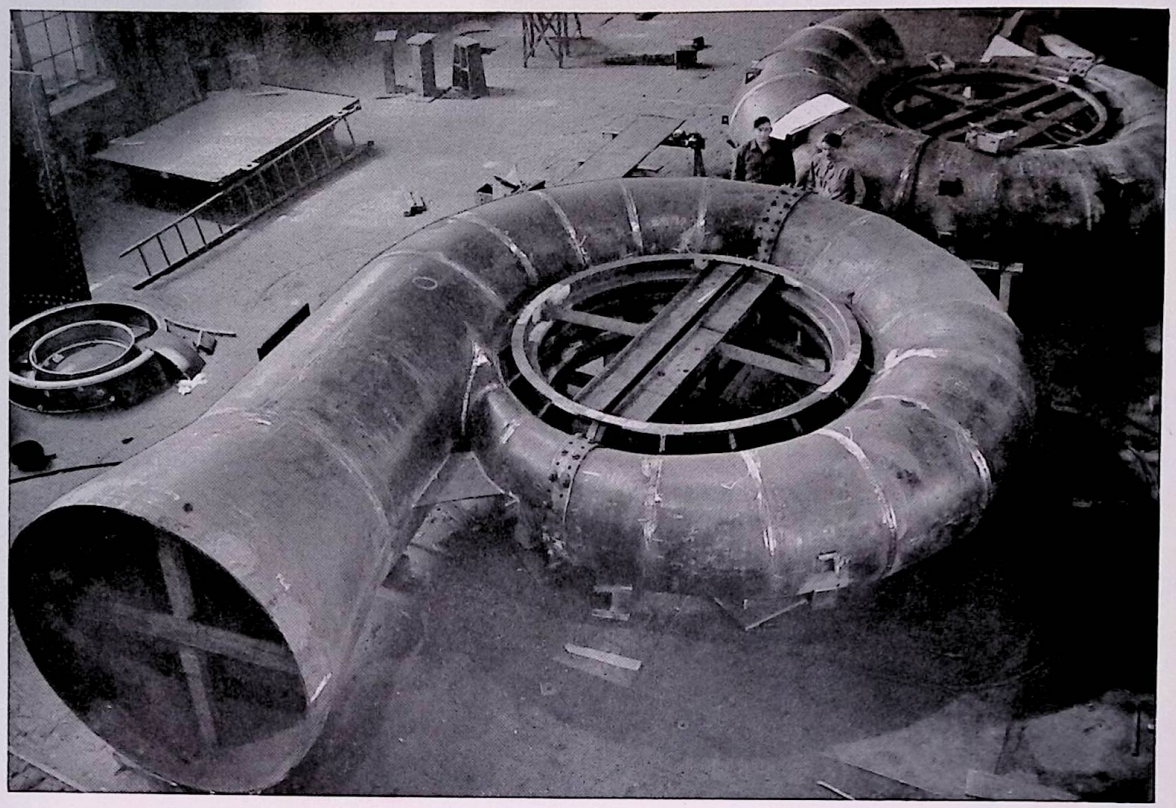
● Interior of powerhouse with fourth runner being lowered into place.

● Corporacion de Fomento de la Produccion, Chile, has recently built two modern hydro stations. To the right is shown one of the four 26,900 H.P. machines which operate under 462.5 feet head at its Abanico Station.

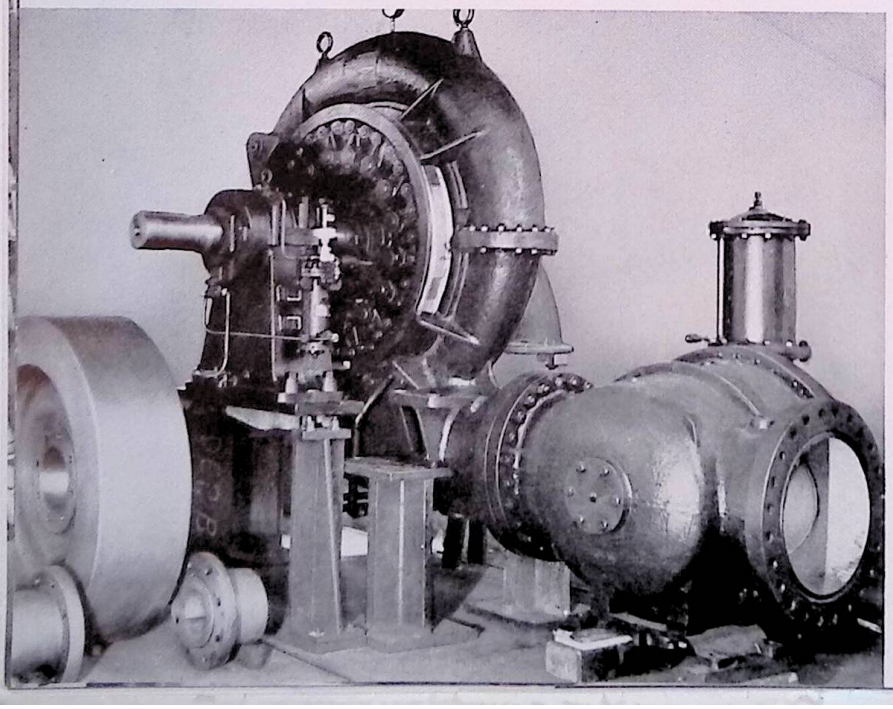


● Interior of its Pilmaquen Plant where two units of 6800 H.P. are operating under 110 feet head, and two additional Smith units of 15,000 H.P. each will be installed.

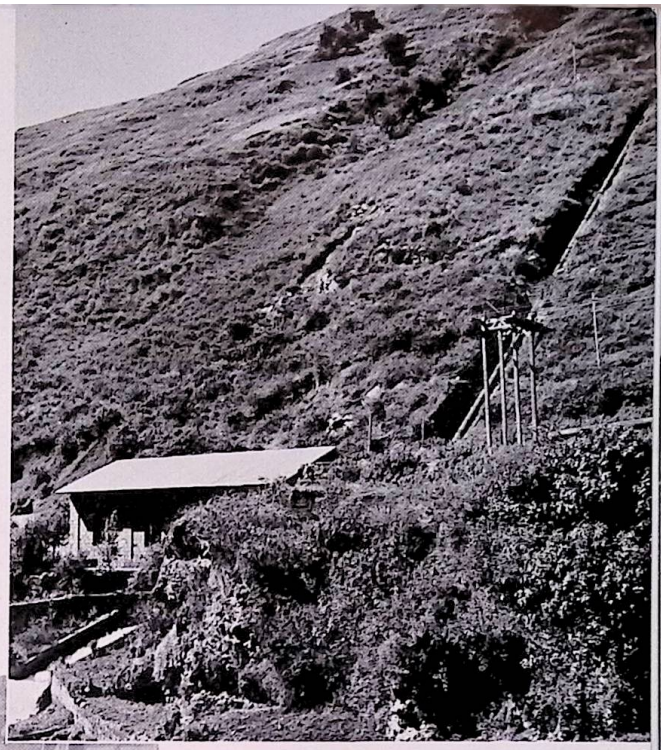




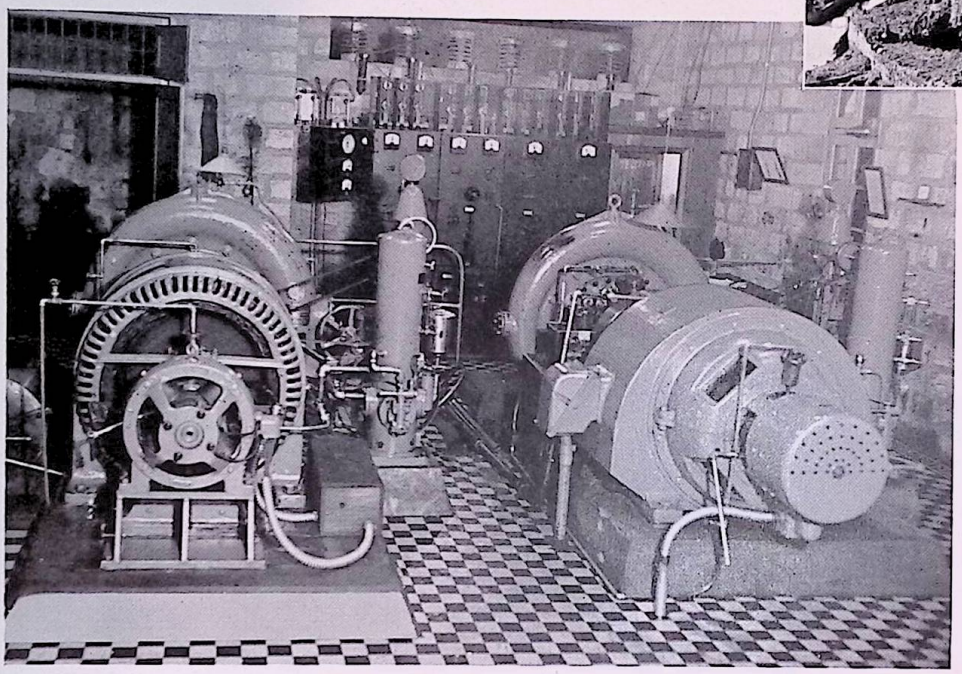
● These 5-foot 6-inch inlet diameter welded steel spiral cases are parts of two 21,500 H.P. Smith-Francis turbines built for Cia. Acos Especias Itabira, Brazil. The units operate under 374 feet head at 400 R.P.M. The cases were shipped in halves and were joined together in the field with riveted butt straps. Note the integrally welded stay rings.

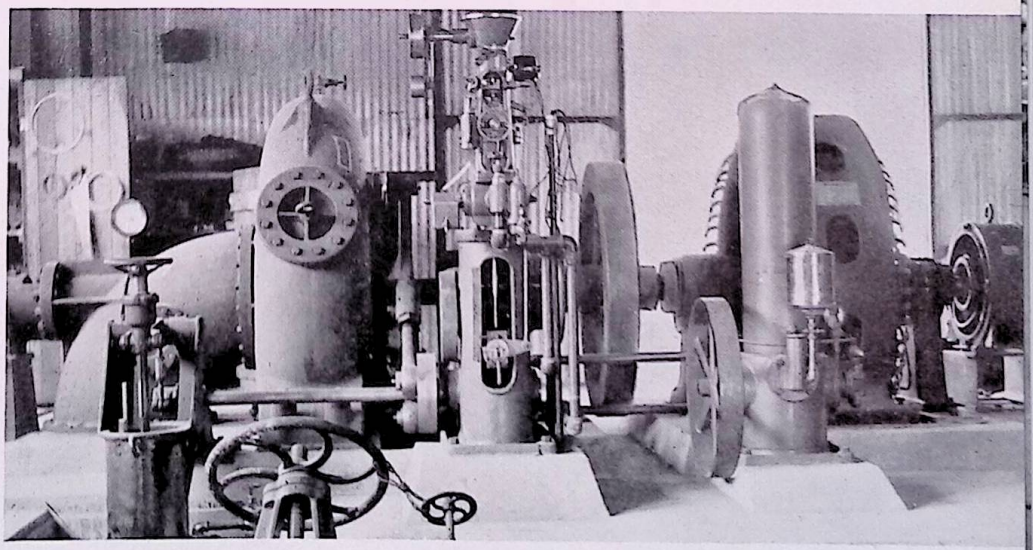


● One of two 5300 H.P. horizontal turbines for the Nuestro Amo Hydroelectric Development, Costa Rica. Head 567 feet, speed 900 R.P.M. A 24-inch hydraulic Rotovalve is used for inlet service. Flywheel is mounted on the shaft between the generator and the turbine.

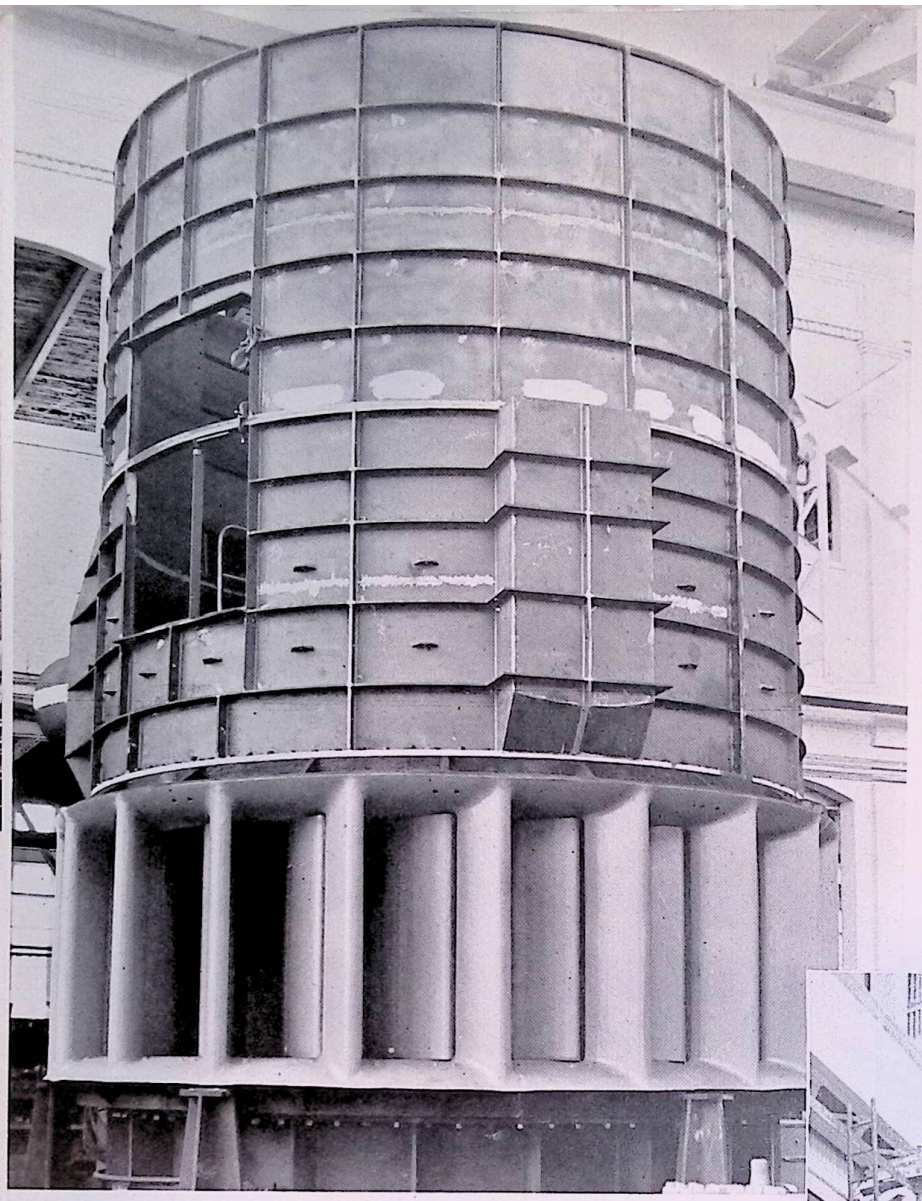


● Power house of the Atacocha Mining Co., Peru. And below is a view of the two Francis units. Each develops 550 H.P. under 360 feet head at 1200 R.P.M.

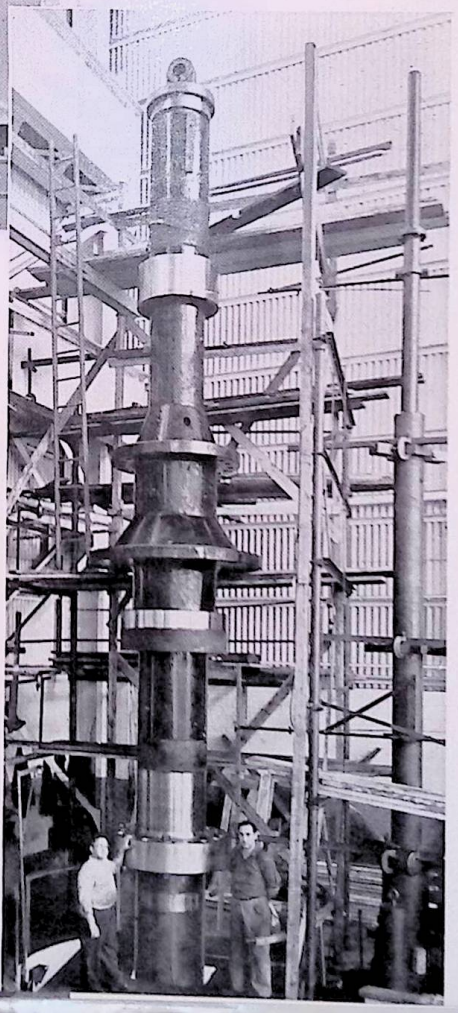




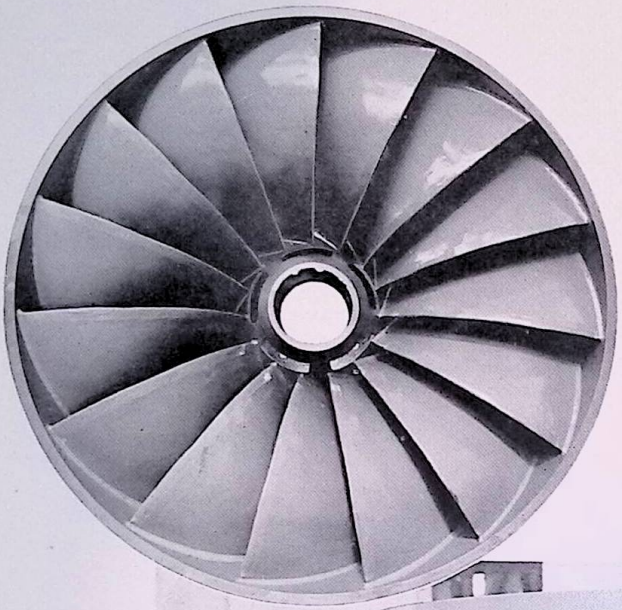
● This 1500 H.P. horizontal Smith-Francis turbine is located in Guatemala. Head 330 feet, speed 900 R.P.M.

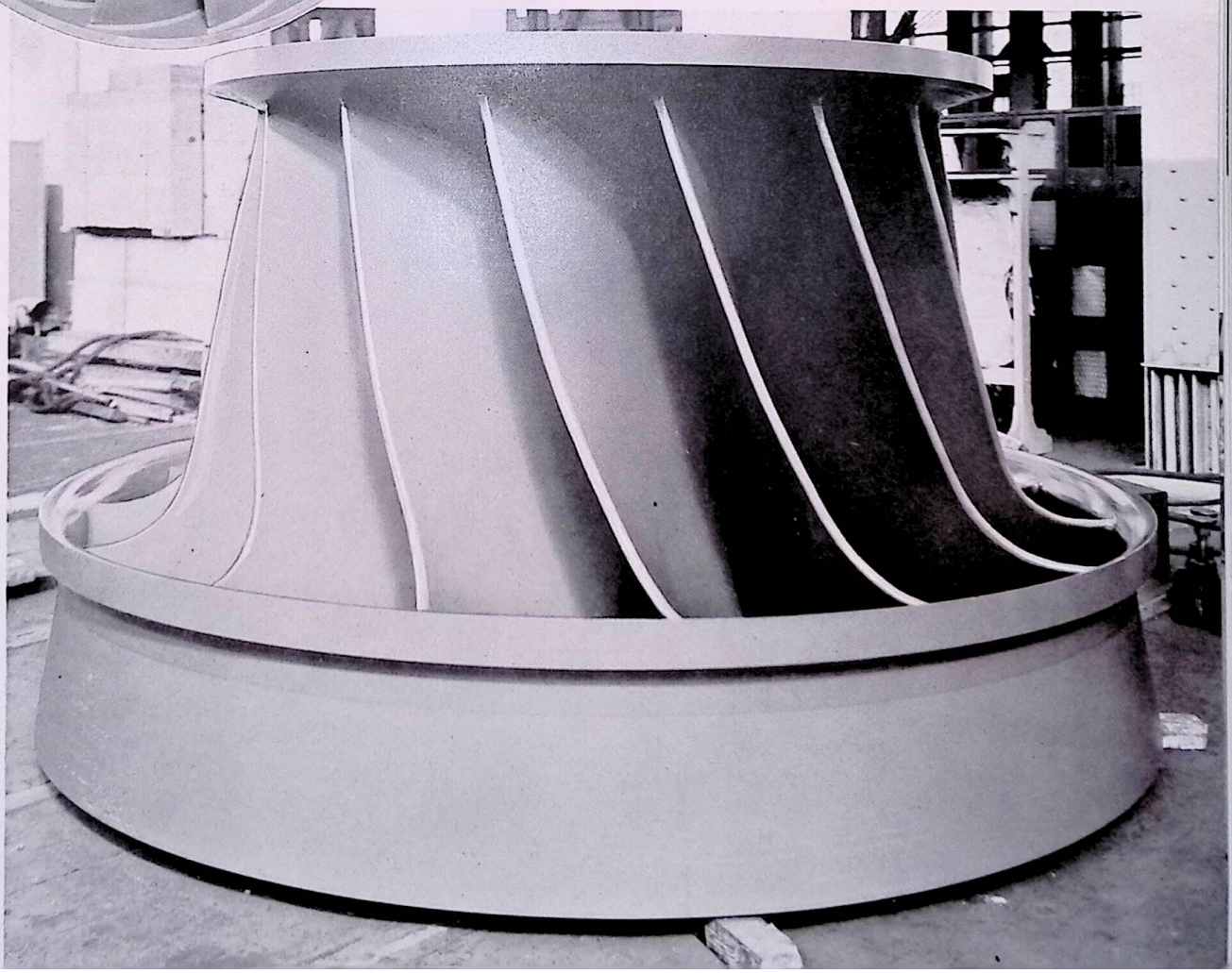


● Shop assembly of stay ring, distributor and plate steel pit liner for one of three 34,600 H.P. units which operate under 78 feet head. These Smith-Francis turbines were recently installed at the Keswick Dam, Sacramento River, California, by the U.S. Bureau of Reclamation.

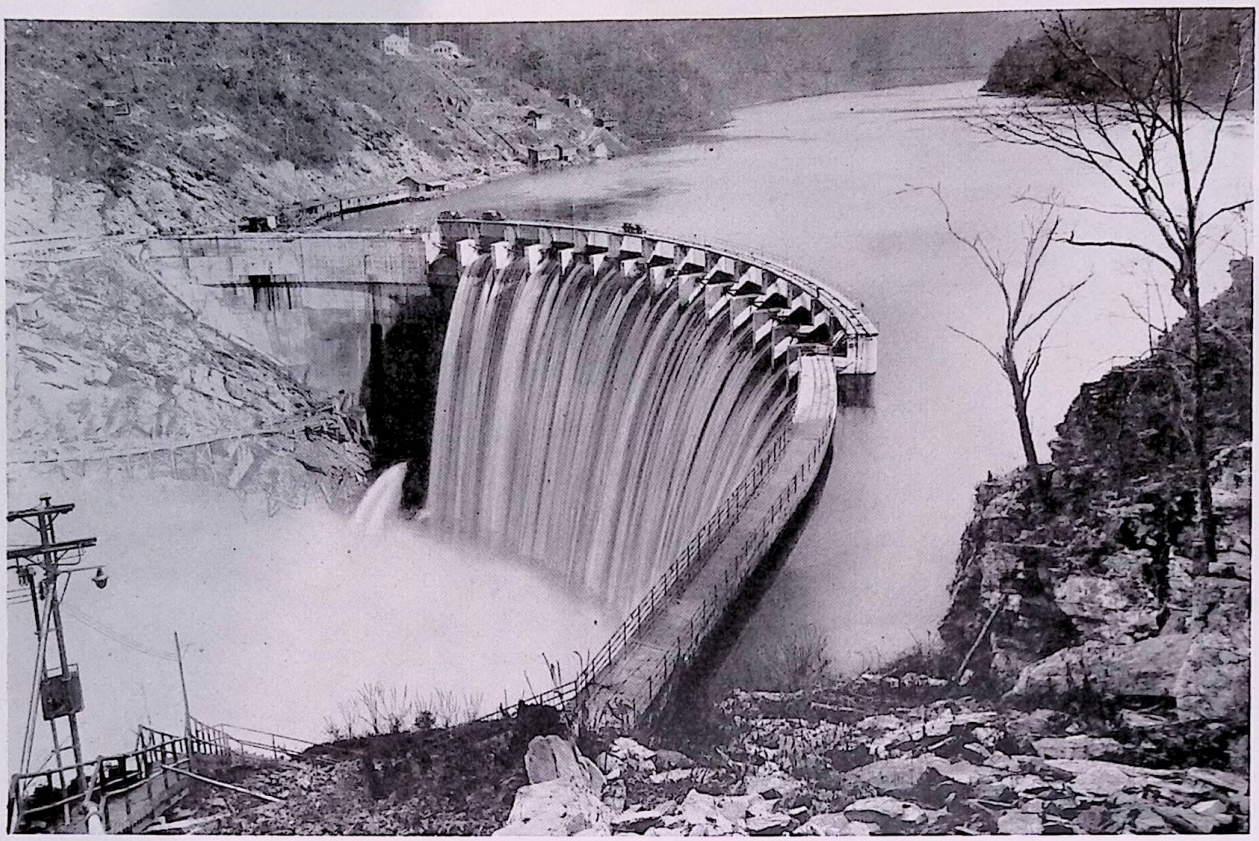


● Keswick turbine and generator shaft assembly on our shaft aligning device. The over-all height including length not seen in pit is 42 feet.

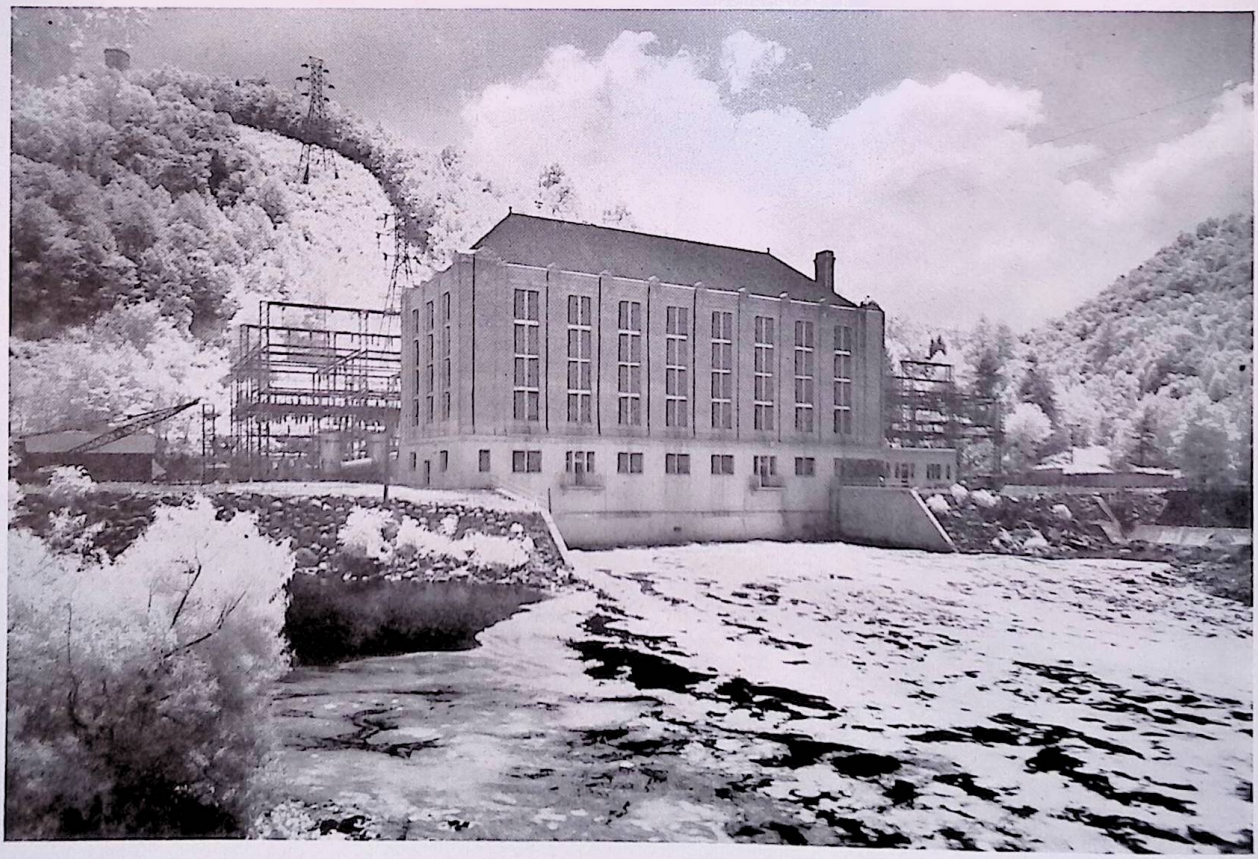




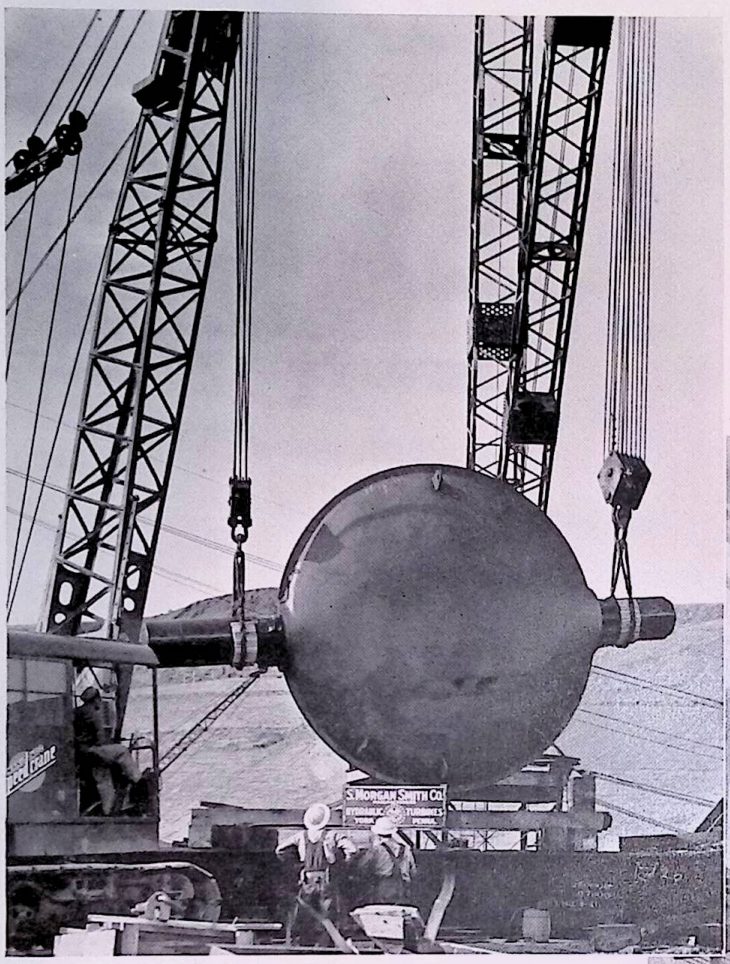
● Two views of the weld fabricated Francis turbine runner which develops 7650 H.P. at 136.3 R.P.M. under 53 feet head for the Ljosafoss Plant in Reykjavick, Iceland. Weight 33,000 pounds. Francis runners of the welded type have been built in small and moderately large sizes and operated successfully under heads up to 120 feet. The crowns and bands are made of cast steel and the welded-in buckets of carbon steel, straight chrome, or chrome-nickel stainless steel plates.



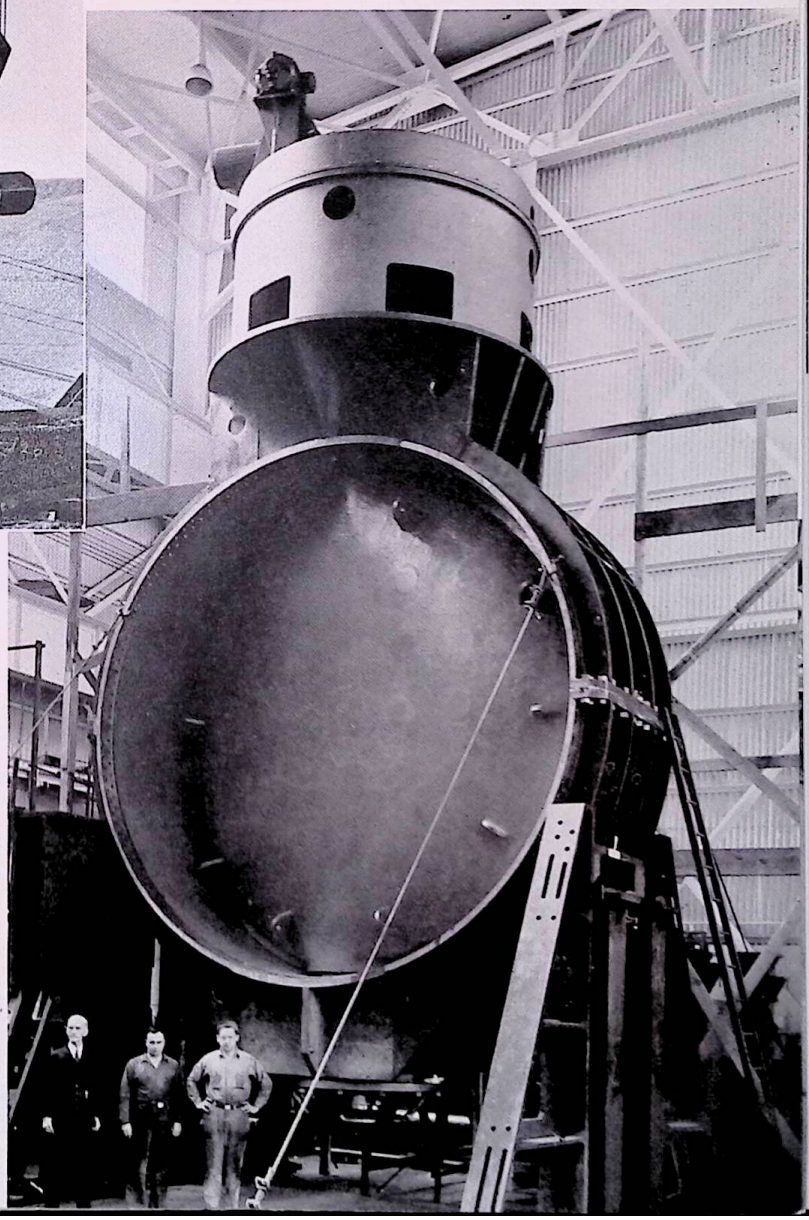
● Carolina Power & Light Co., Walters Plant on the Pidgeon River, North Carolina.
Three vertical Smith turbines each developing 57,000 H.P. under 840 feet head are installed here.



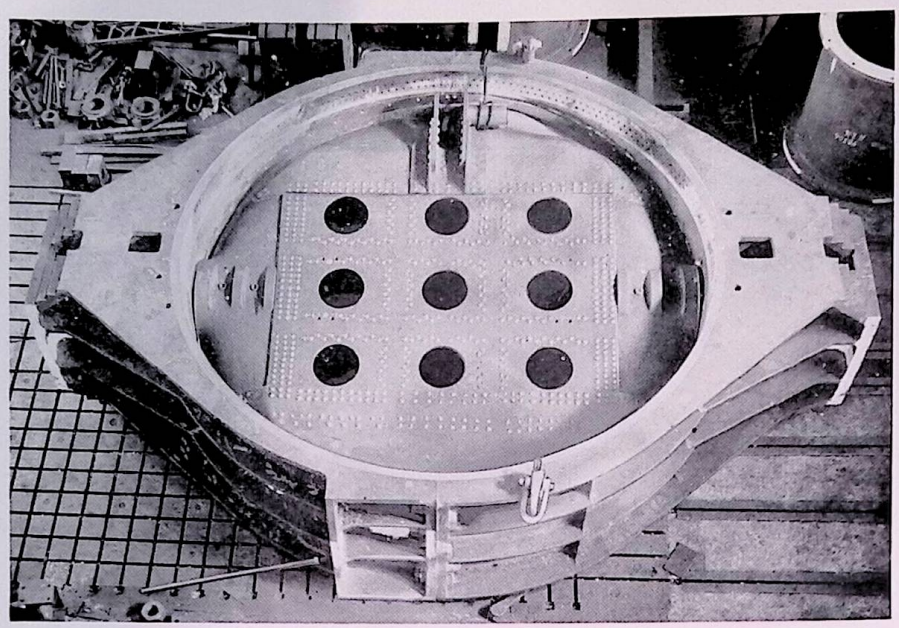
VALVES *by* SMITH



● Unloading a 75-ton valve disc at the U.S. Engineers' Fort Peck Dam, Montana, with a 40-ton stiff leg crane and a 50-ton locomotive crane.

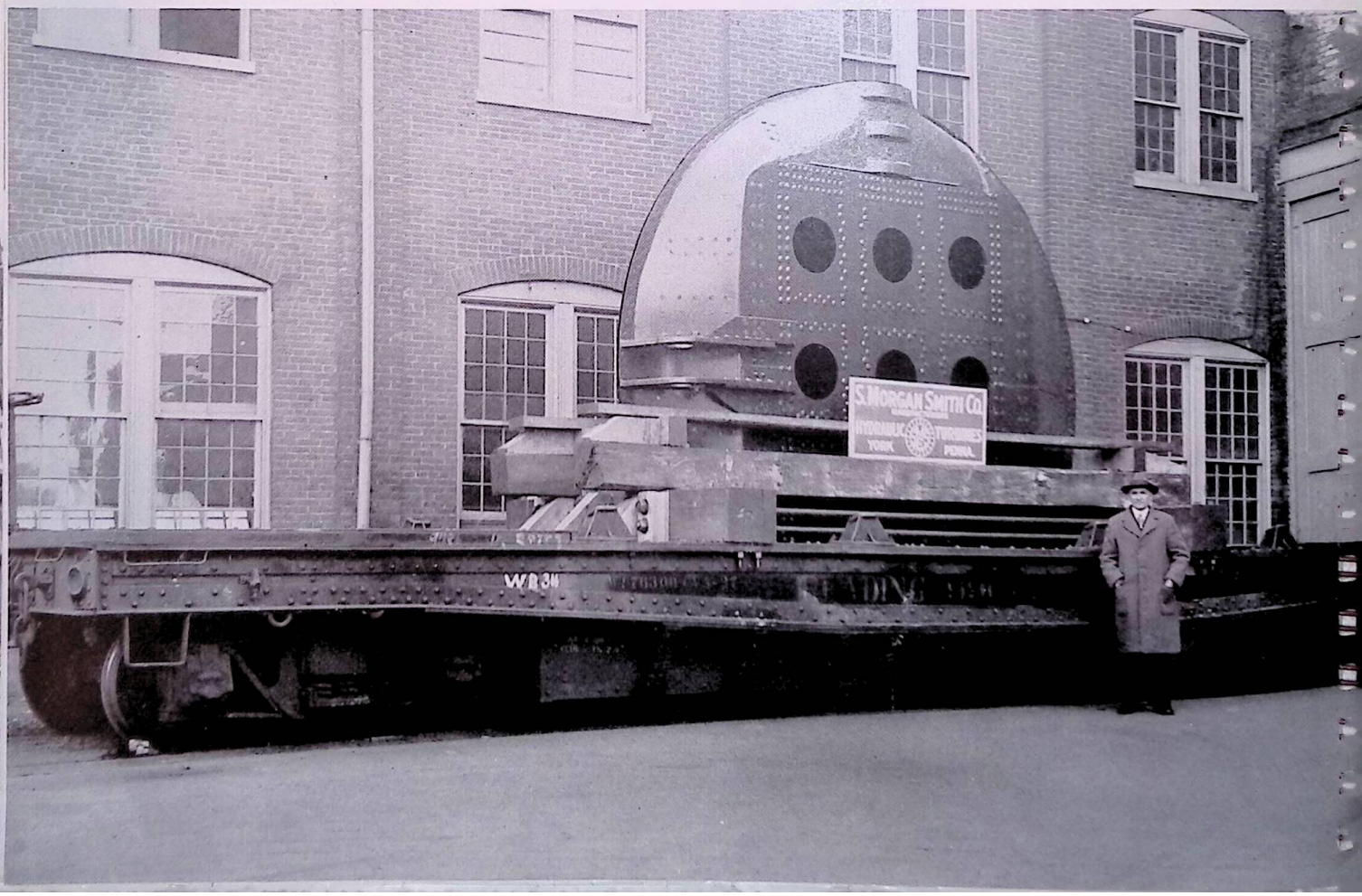


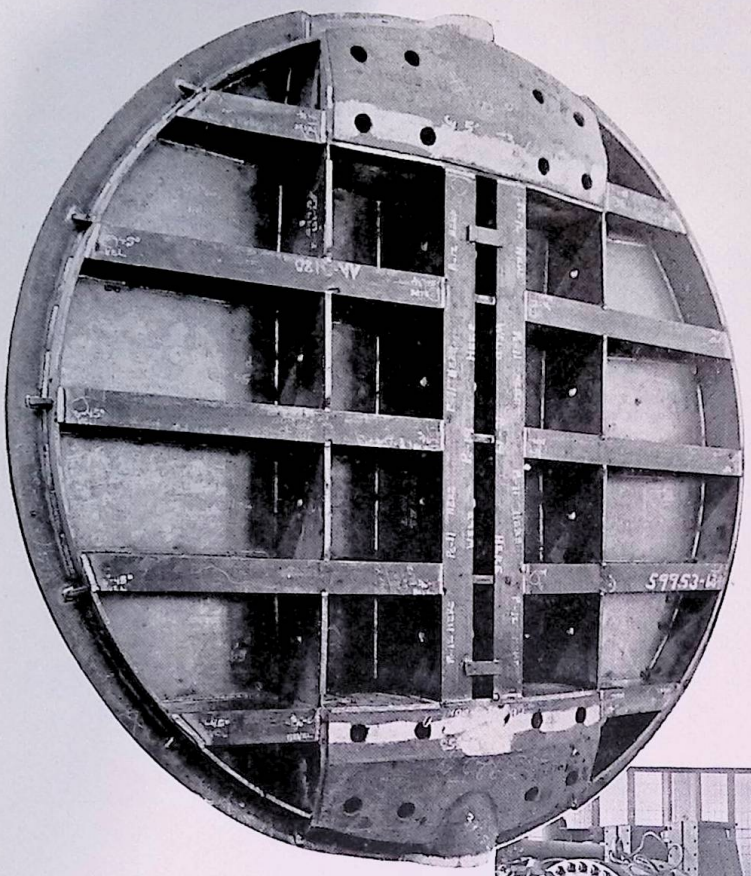
● Shop assembly view of one of two 16-foot Butterfly valves for turbine inlet service at the above mentioned Power Site.



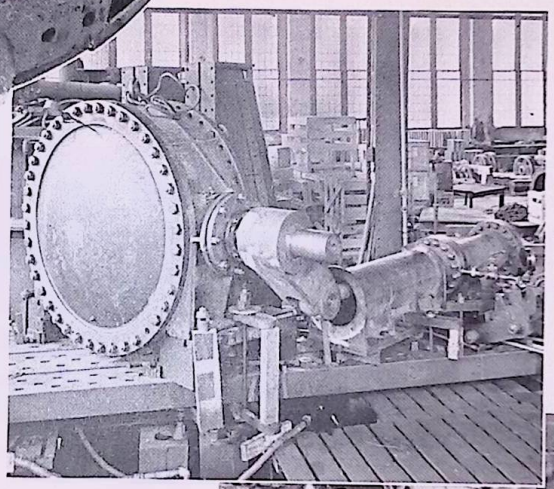
● Shop view of a 16-foot Dow disc arm pivot valve for 180 feet head. Note riveted, cast and structural steel design as built for New England Power Company, Fifteen Mile Falls Development.

● Valve disc loaded and ready for shipment.

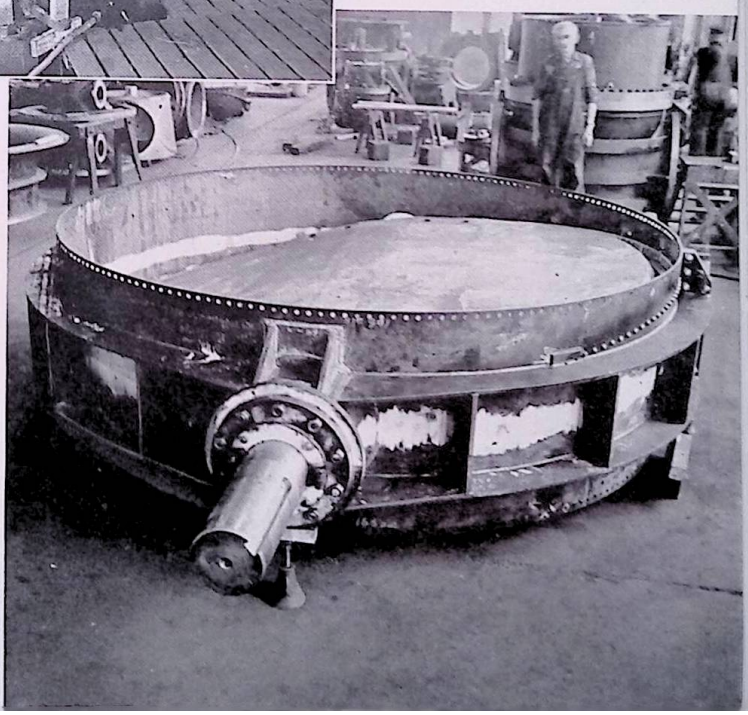




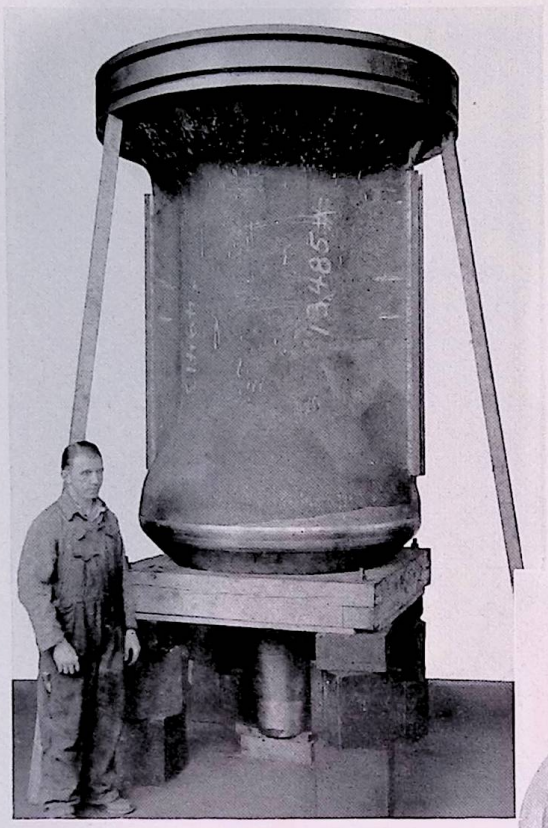
● Partial assembly of a 14-foot Butterfly valve disc. Welded, cast and structural steel design.



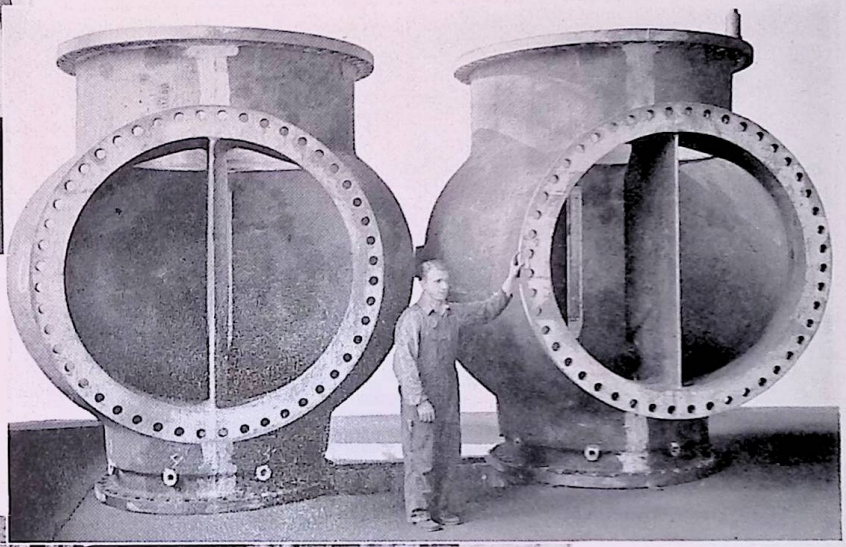
● Shop pressure testing of hydraulically operated 57-inch Butterfly valve for U.S. Engineers, Conchas Dam; operating head, 150 feet.



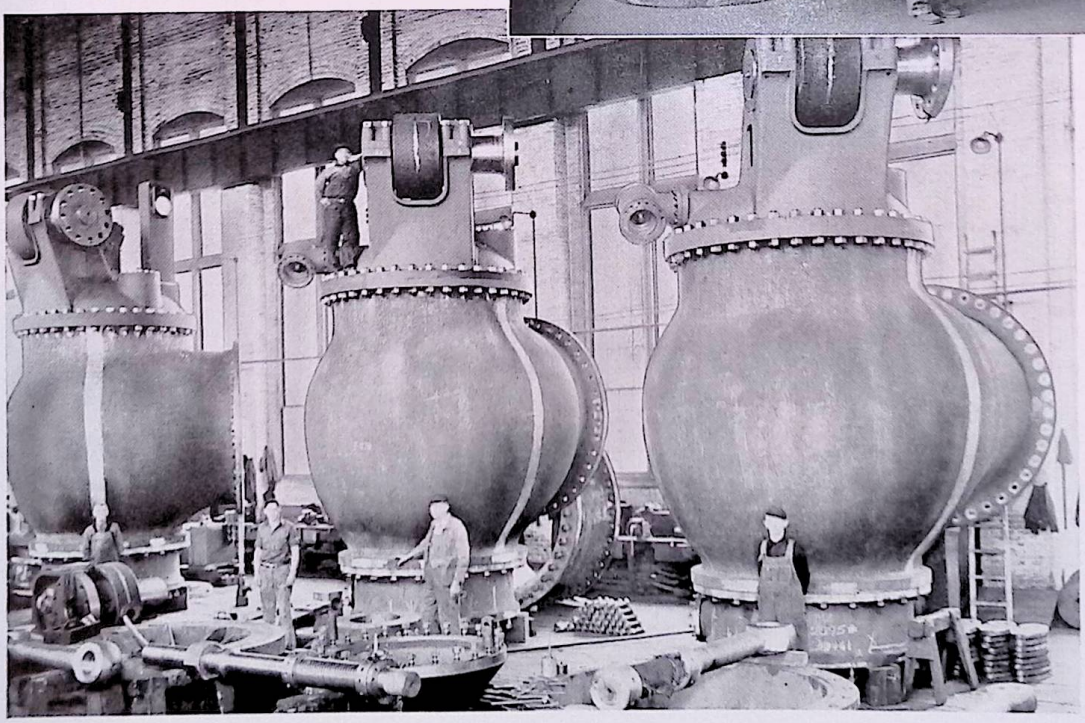
● Shop assembly of 14-foot disc as described above and body of welded design for Hydraulic Race Company, Lockport, New York; operating head, 46 feet.

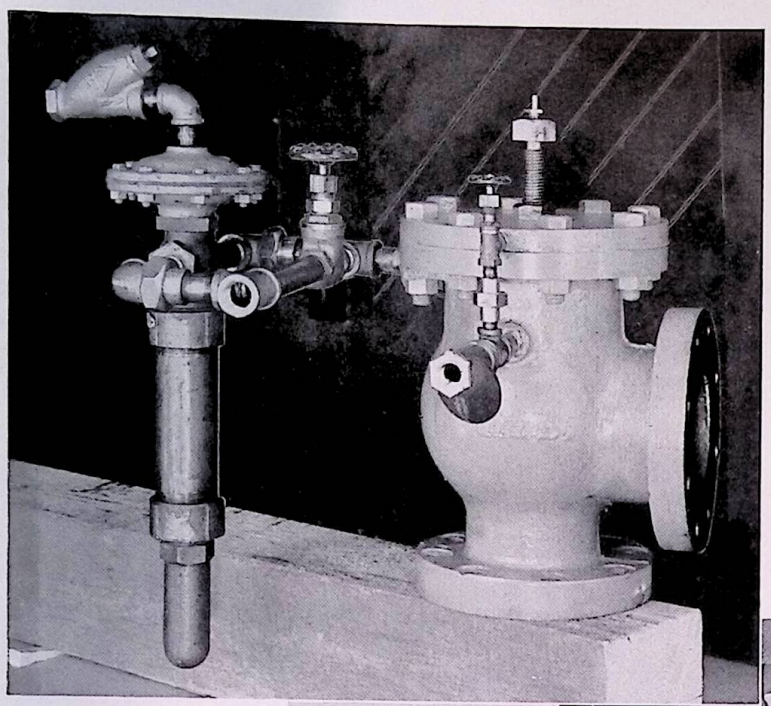


● Views of piston and housings for two 52-inch discharge diameter pressure regulators. These two valves were furnished with the 90,700 H.P. Smith-Francis turbines which operate under 327 feet head at Diablo Dam, City of Seattle, Washington.



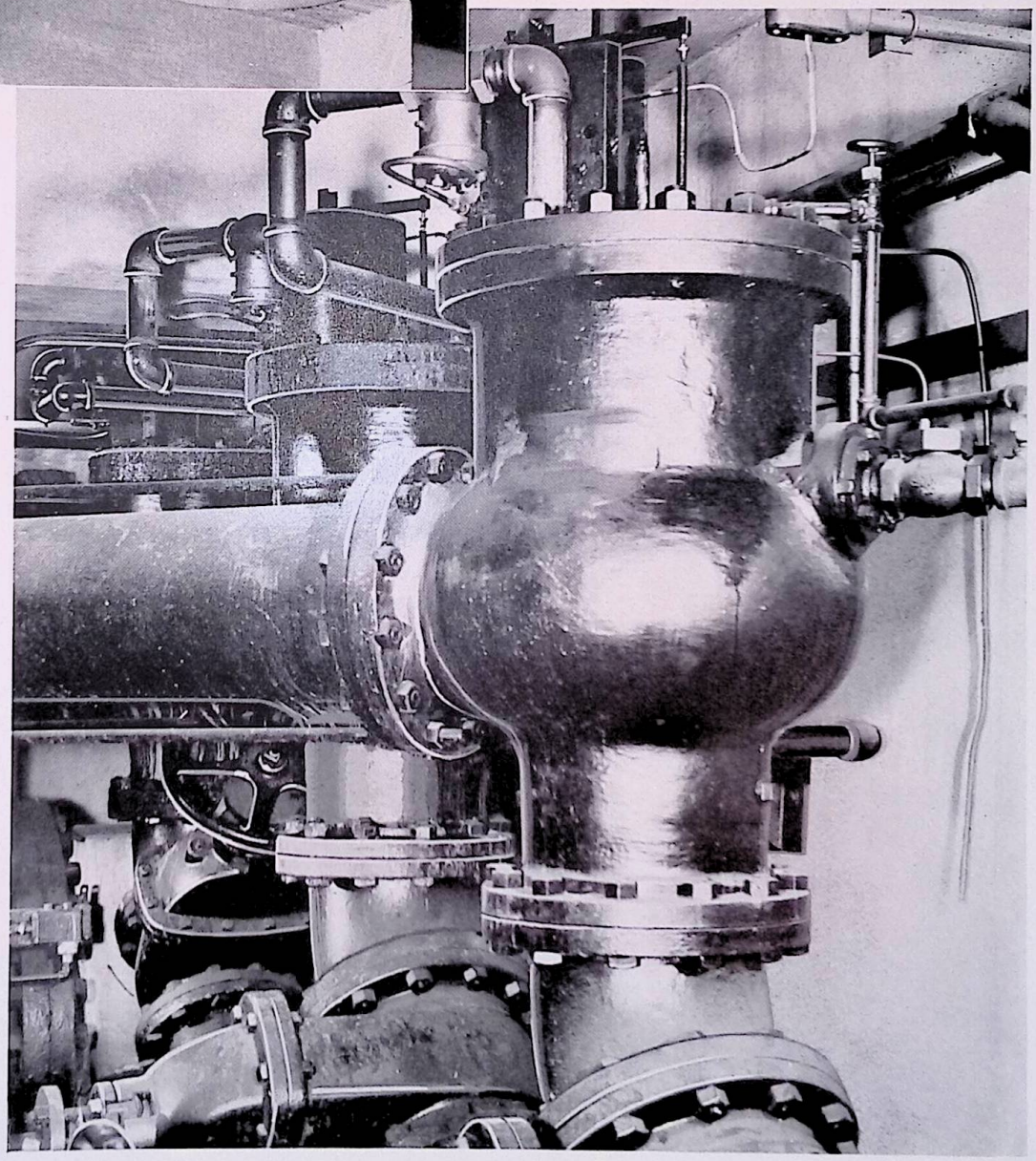
● Three 59-inch turbine pressure regulators which operate under 590 feet head at Hoover Dam, U. S. Bureau of Reclamation.

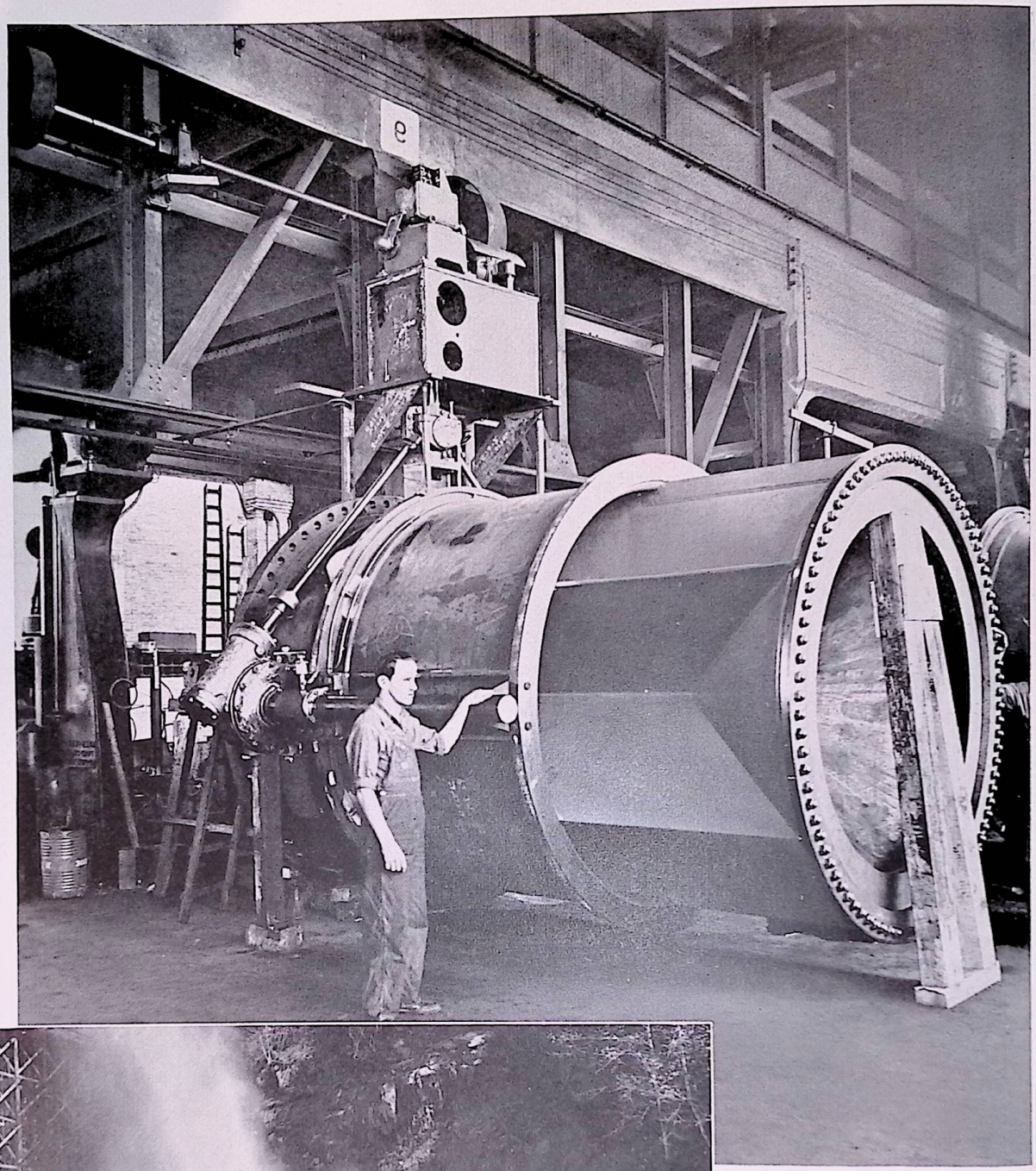


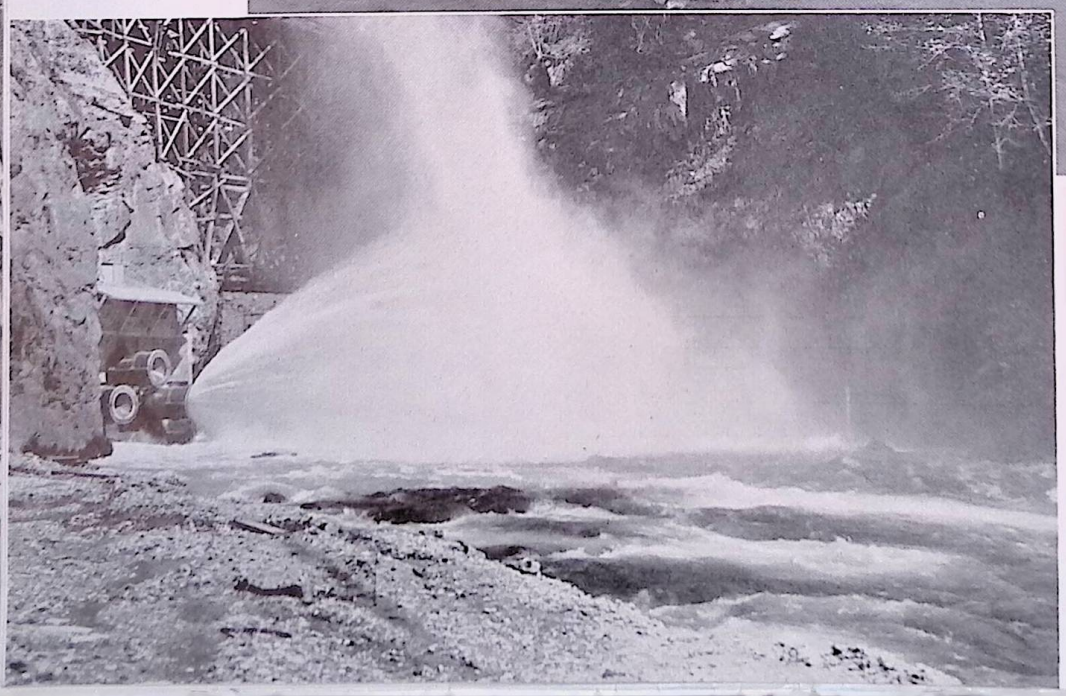


● Four-inch standard Angle Needle type surge relief valve.

● Three of five 10-inch Angle Needle surge relief valves are shown installed in a very large Butadiene plant.

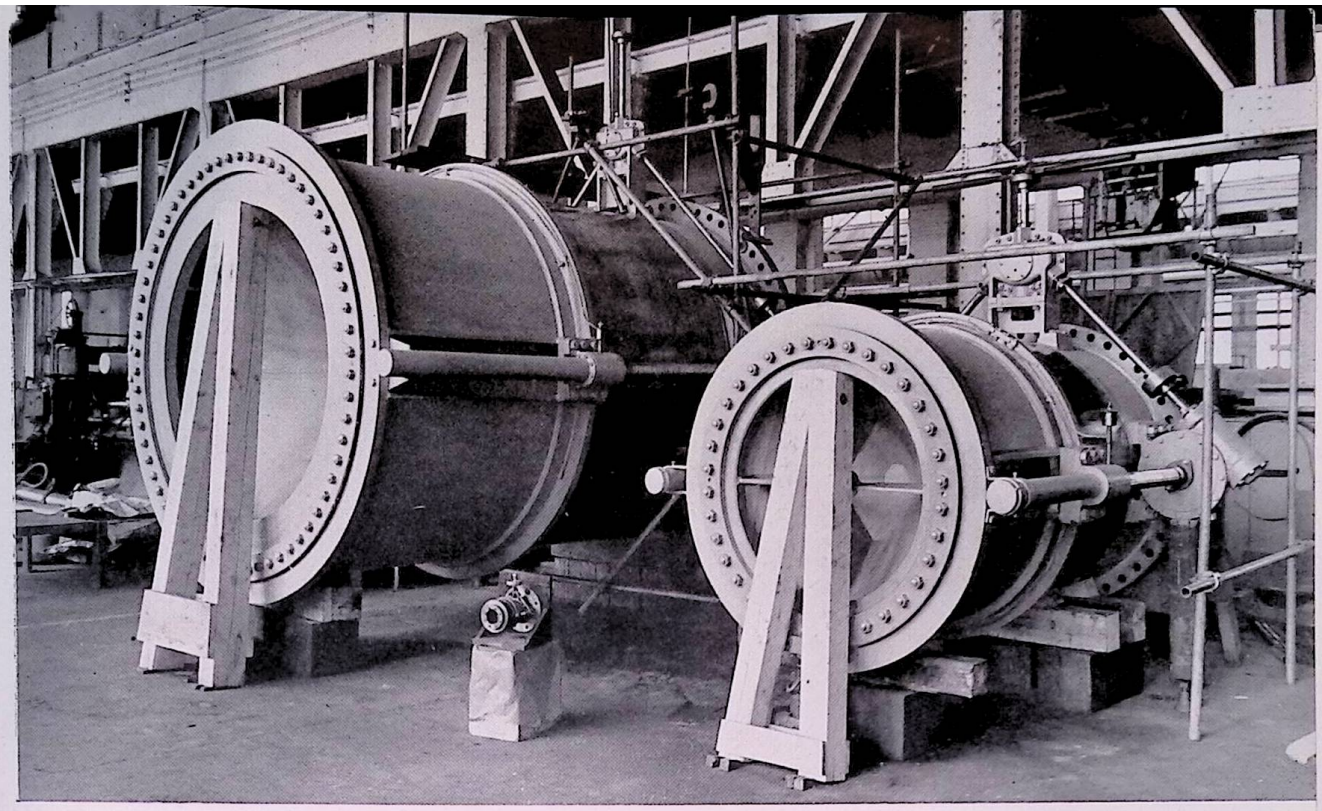






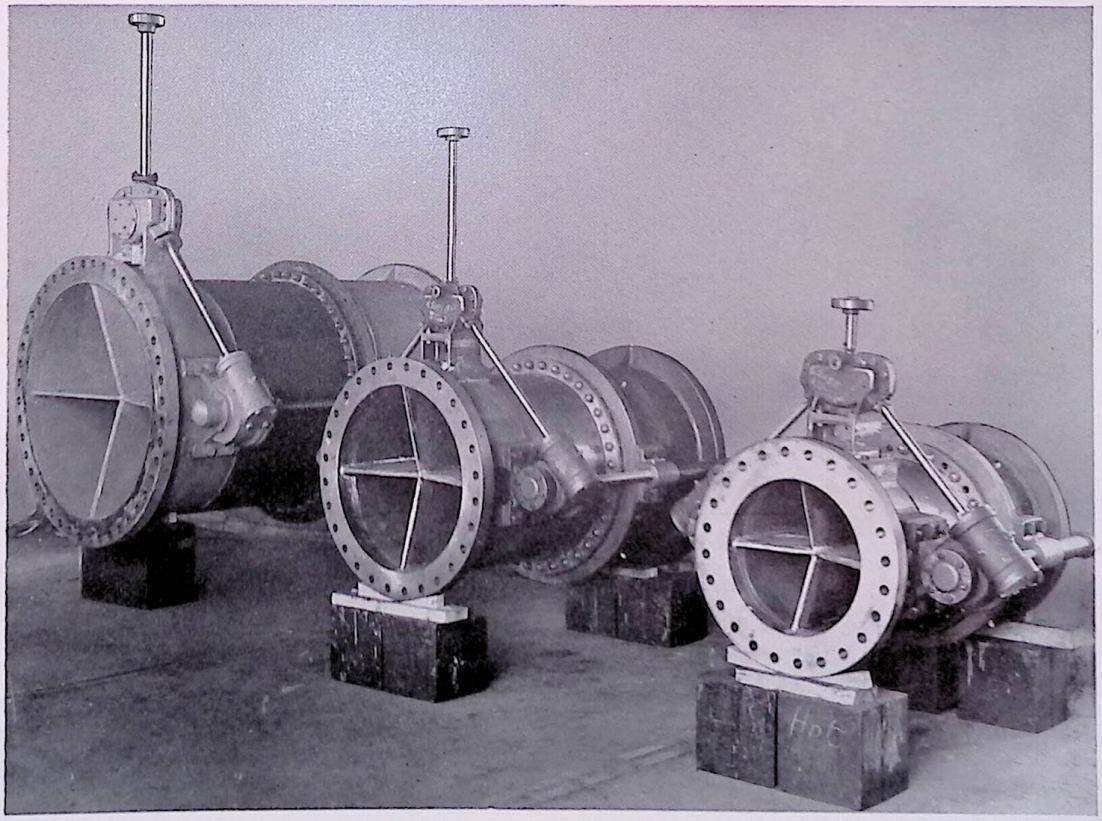
● Above: Shop assembly of 96 inch Howell-Bunger free discharge valve with valve port open.

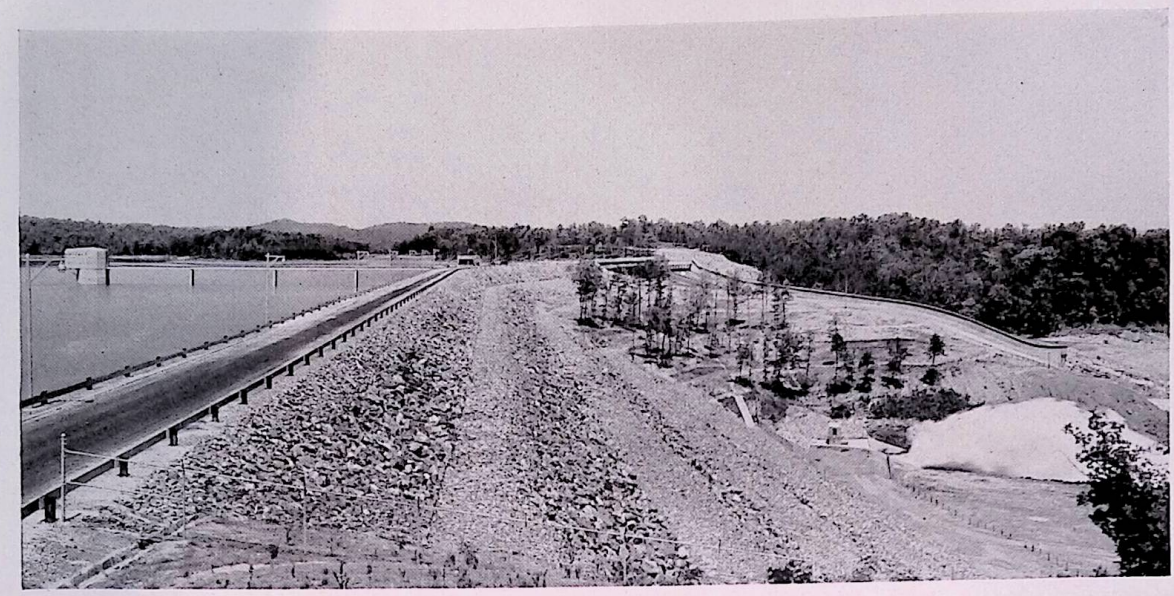
● Left: A battery of three 96-inch Howell-Bunger valves designed for 420 feet head at the discharge control outlet at Mud Mountain Dam, White River, Washington, a U.S. Engineers' Flood Control Project.



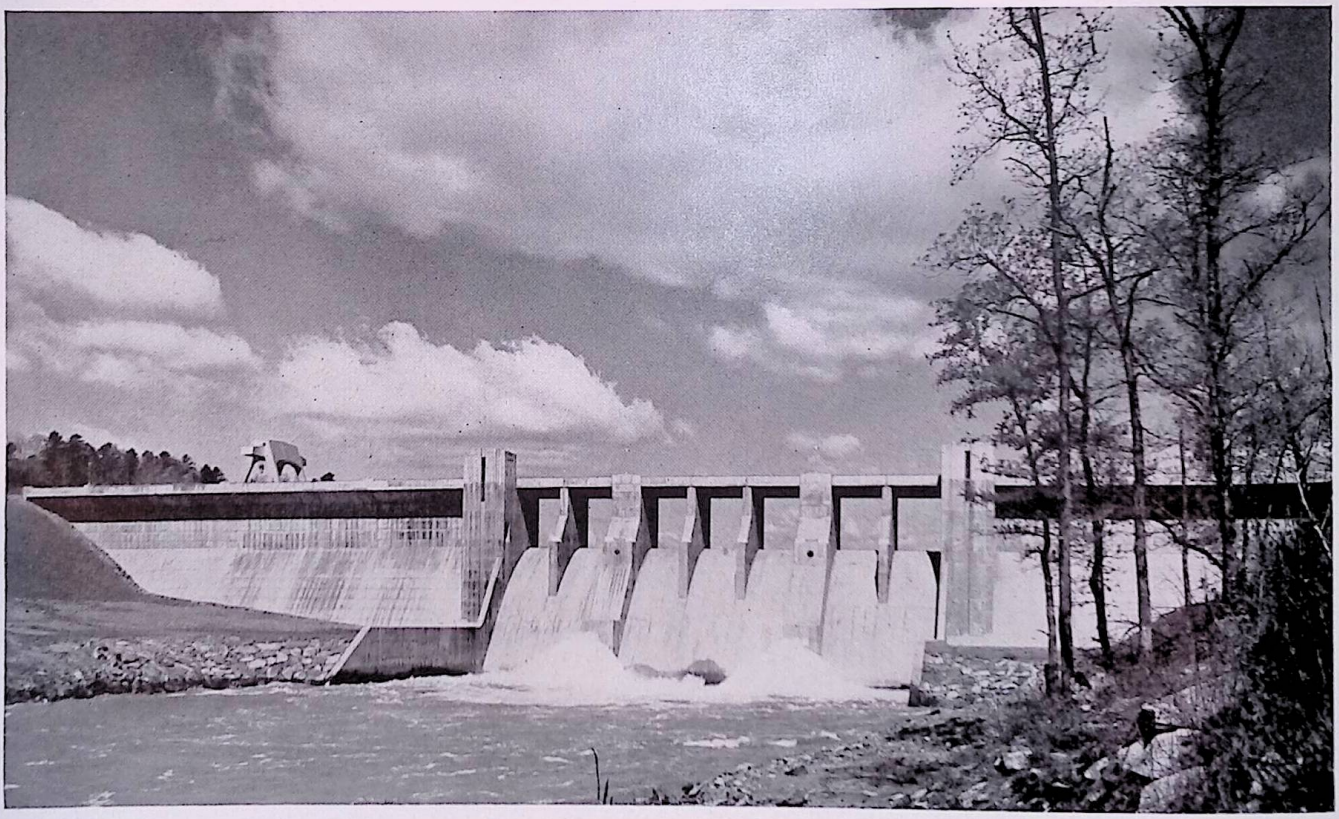
A view of a 96-inch Howell-Bunger valve for the Nueva Cia Electrica de Chapala, Colimillo Dam, Mexico. Head 274 feet. Also, a 54-inch valve of the same type for the Comision Federal de Electricidad, Valle de Bravo Dam, Mexico. Head 138.5 feet.

A 48-inch Howell-Bunger valve for installation at the Allatoona Dam, Georgia, of the T.V.A., shown with similar 30-inch and 20-inch units for use in Uruguay.

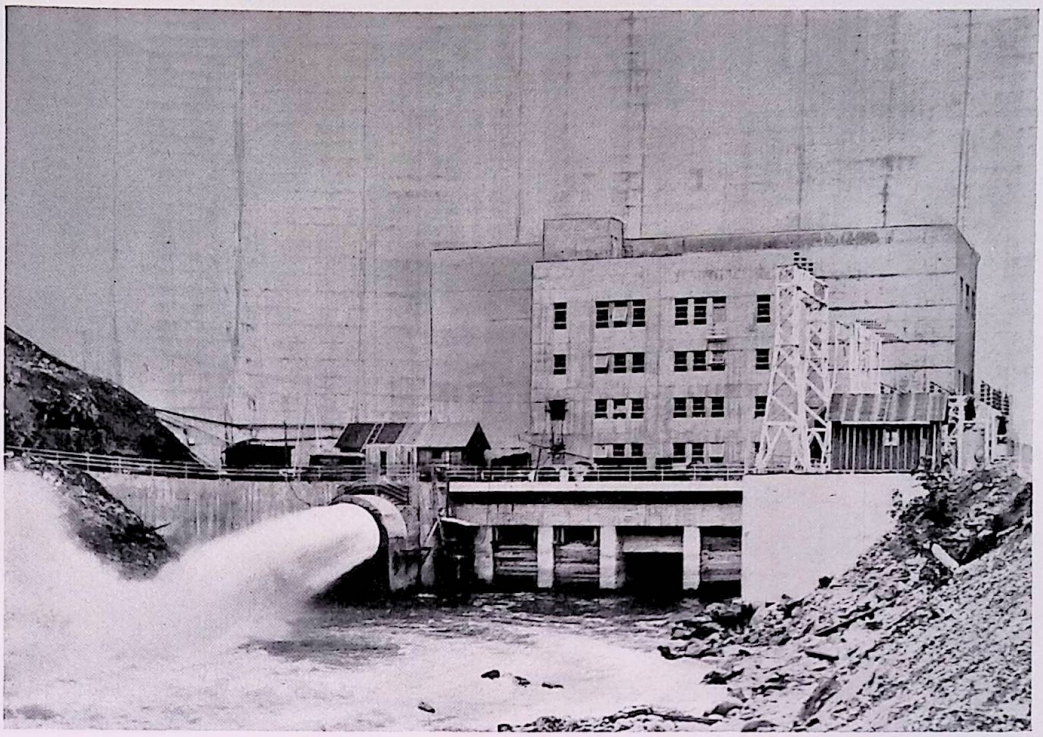




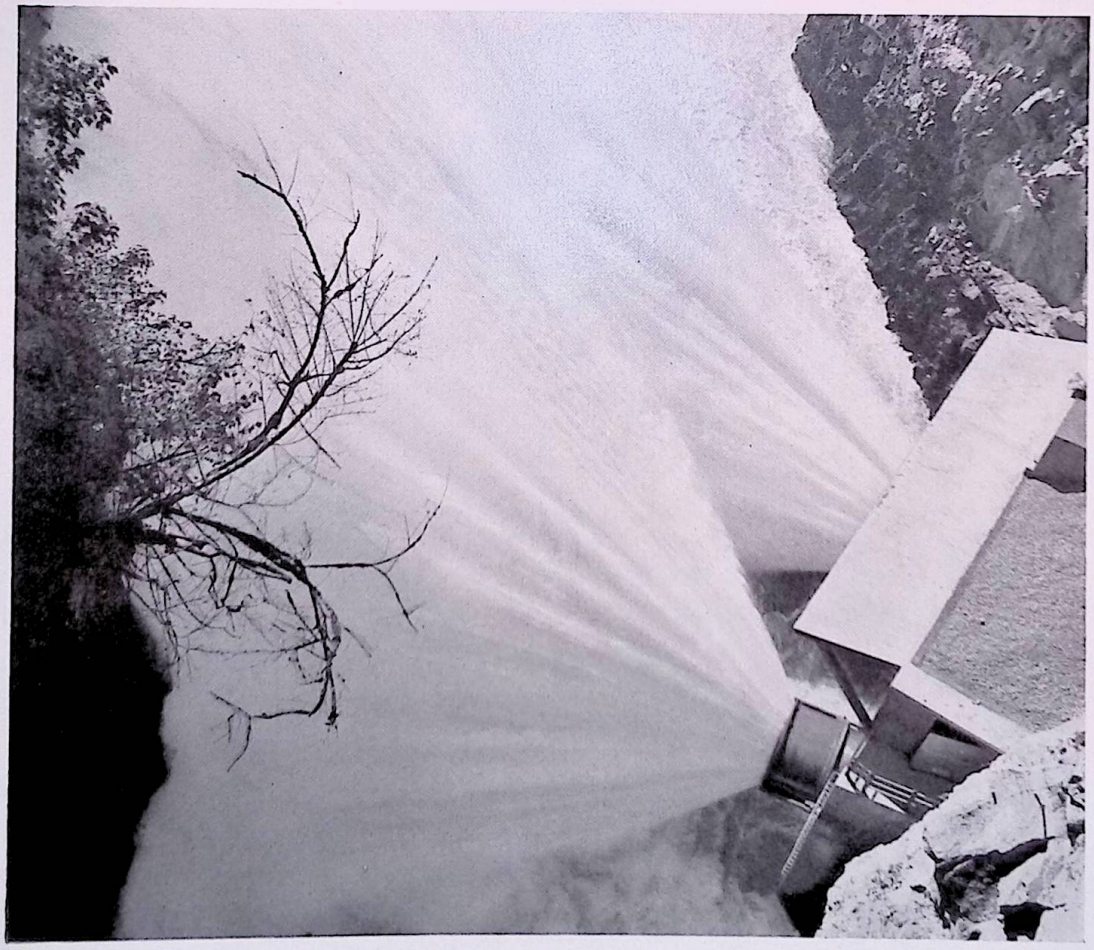
● View of Nottely Dam, Tennessee Valley Authority, showing the discharge from the 78-inch Howell-Bunger valve located at the base of the downstream face of the Dam.



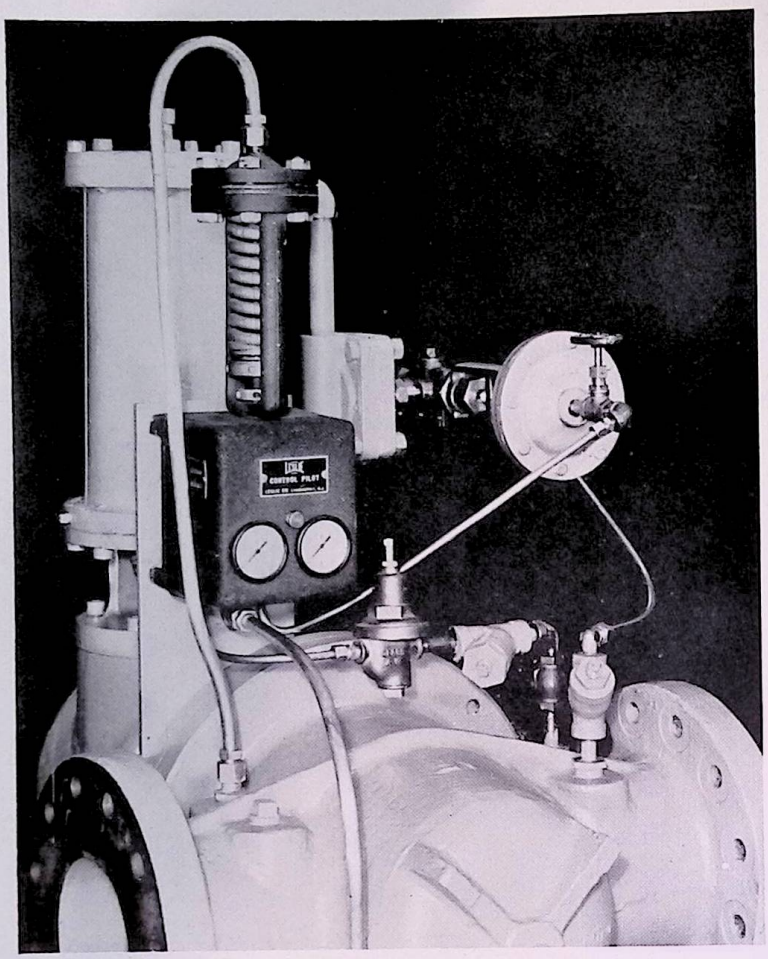
● Two 60-inch Howell-Bunger valves discharging at Nimrod Dam, Fourche La Fave River, Ola, Arkansas.



● A 66-inch Howell-Bunger valve discharging through a hood at Alder Dam, City of Tacoma, Washington.

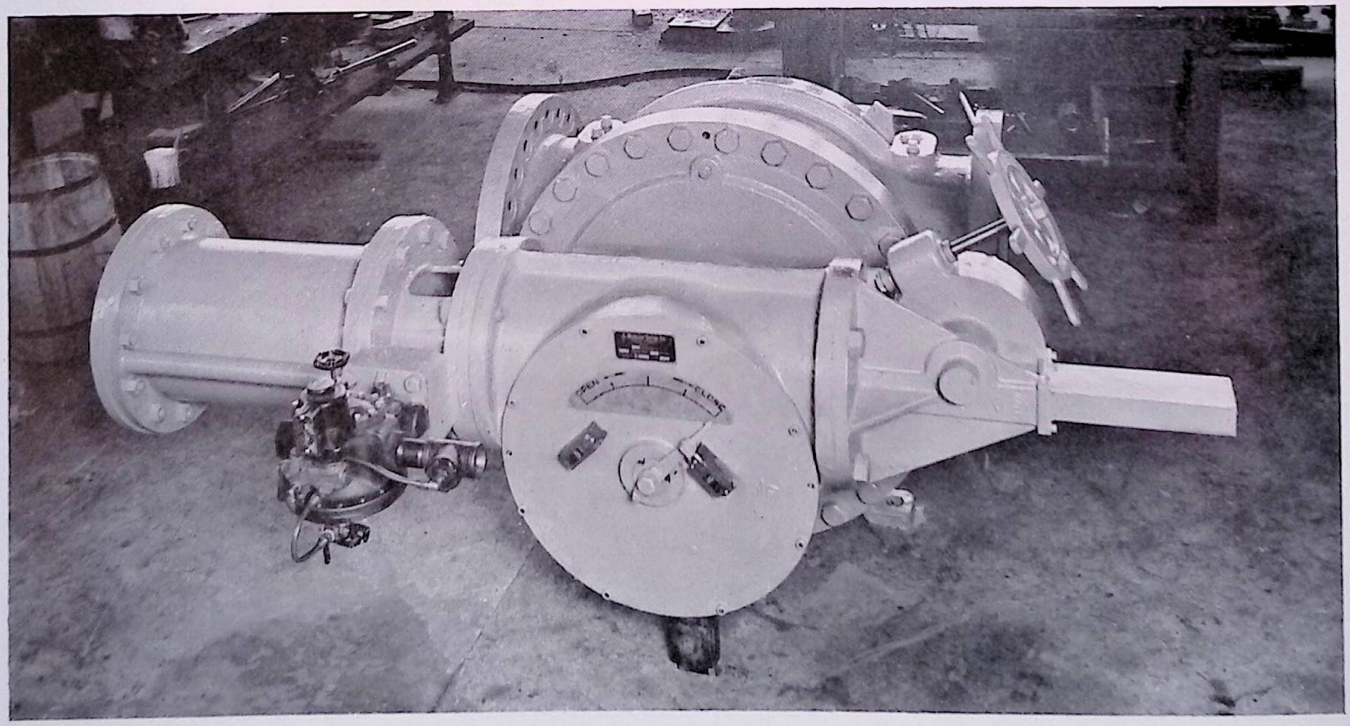


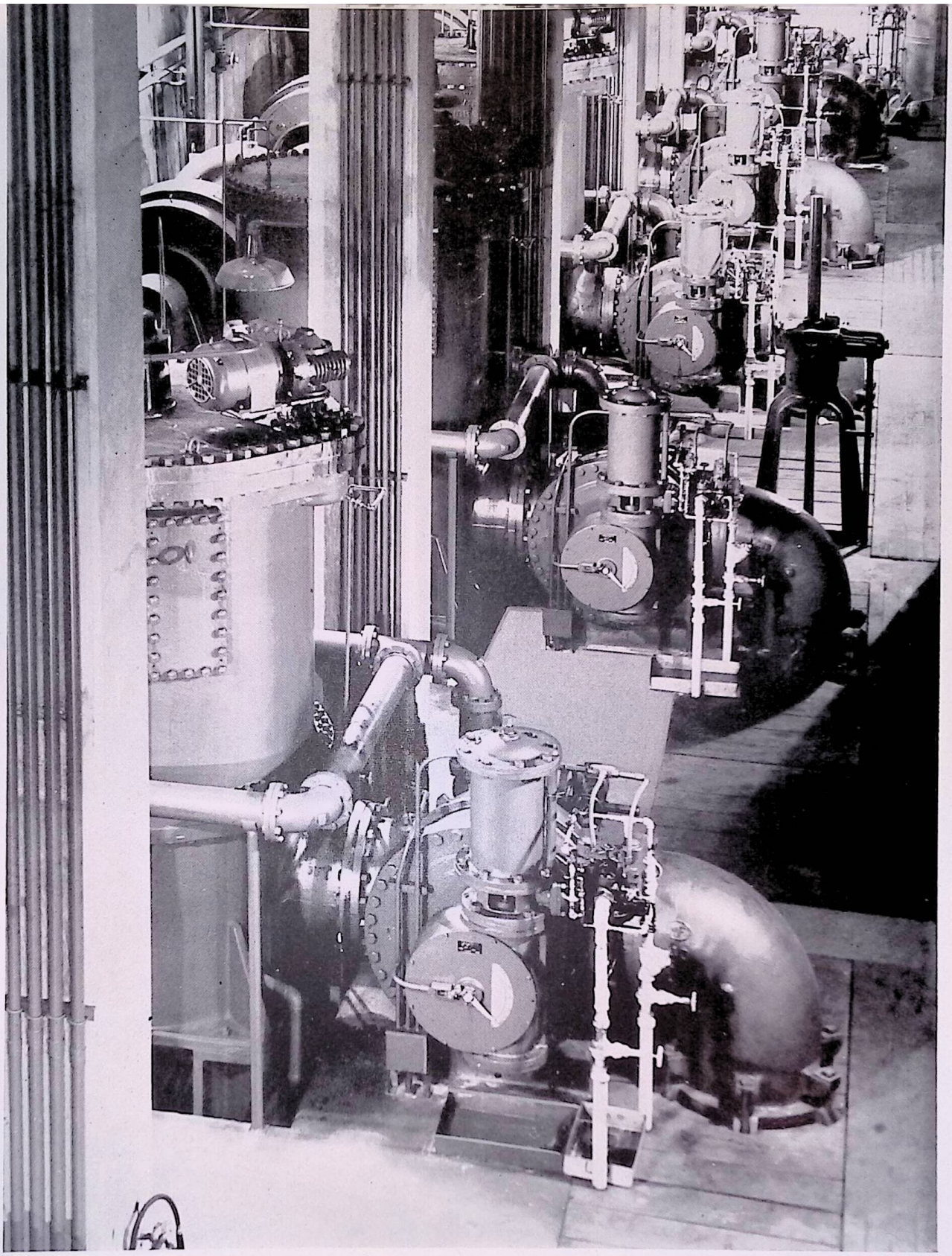
● Two of the three 96-inch Howell-Bunger valves discharging at 1/6th gate opening under 170 feet head at Mud Mountain, pictured on page 32.



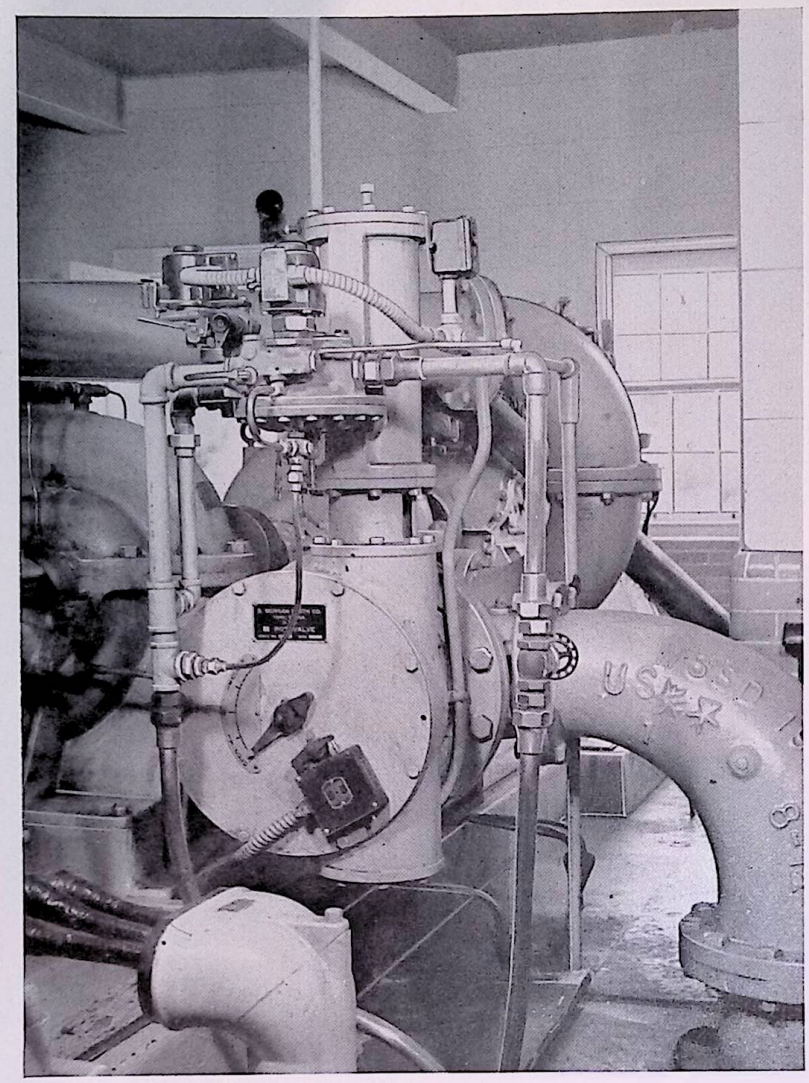
● View of hydraulic Pressure Regulating control on a six-inch Rotovalve installed in the City of San Francisco, California, Water Department.

● A 20-inch hydraulic Rotovalve with Auxiliary Manual control.

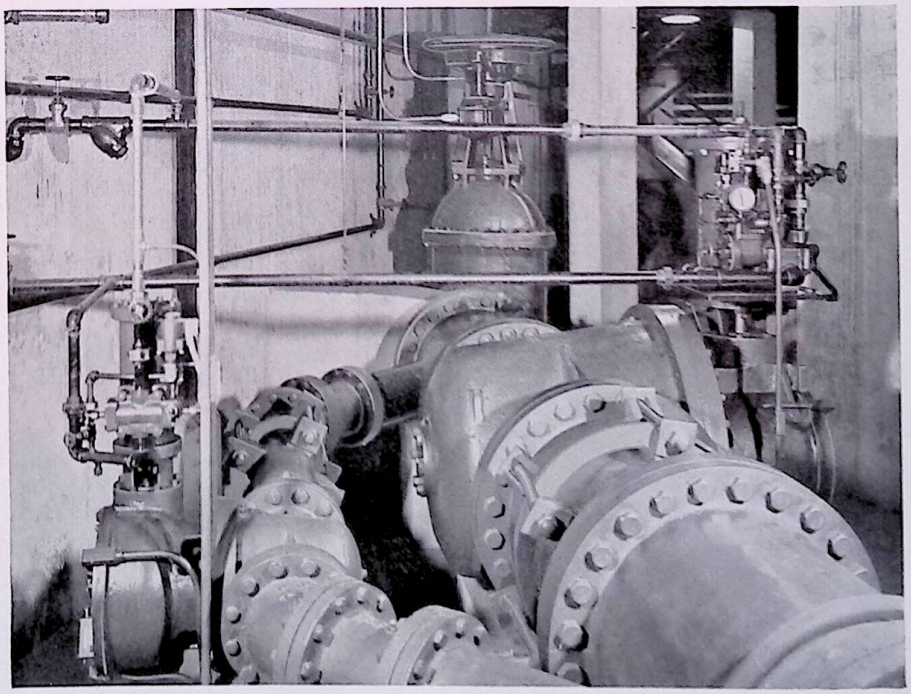




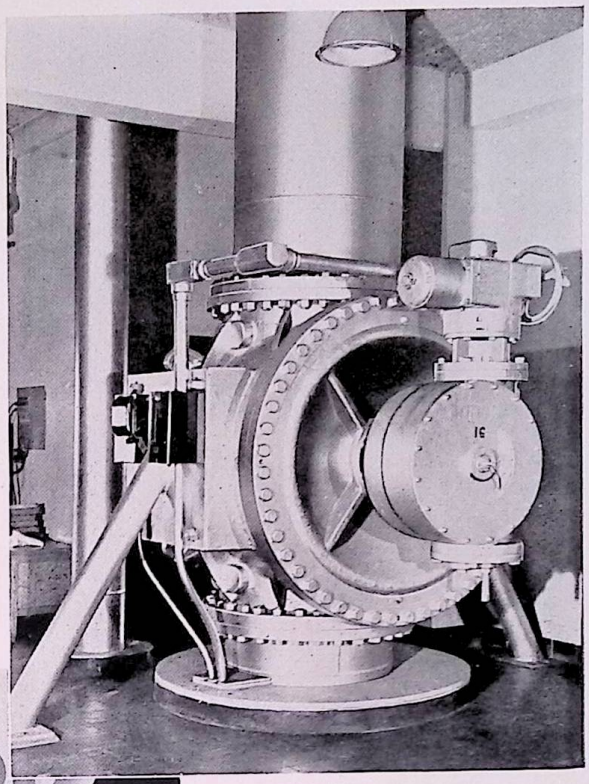
● Five of six 24-inch Rotovalves with Solenoid controls, installed for pump check service in a large government-owned Butadiene plant.



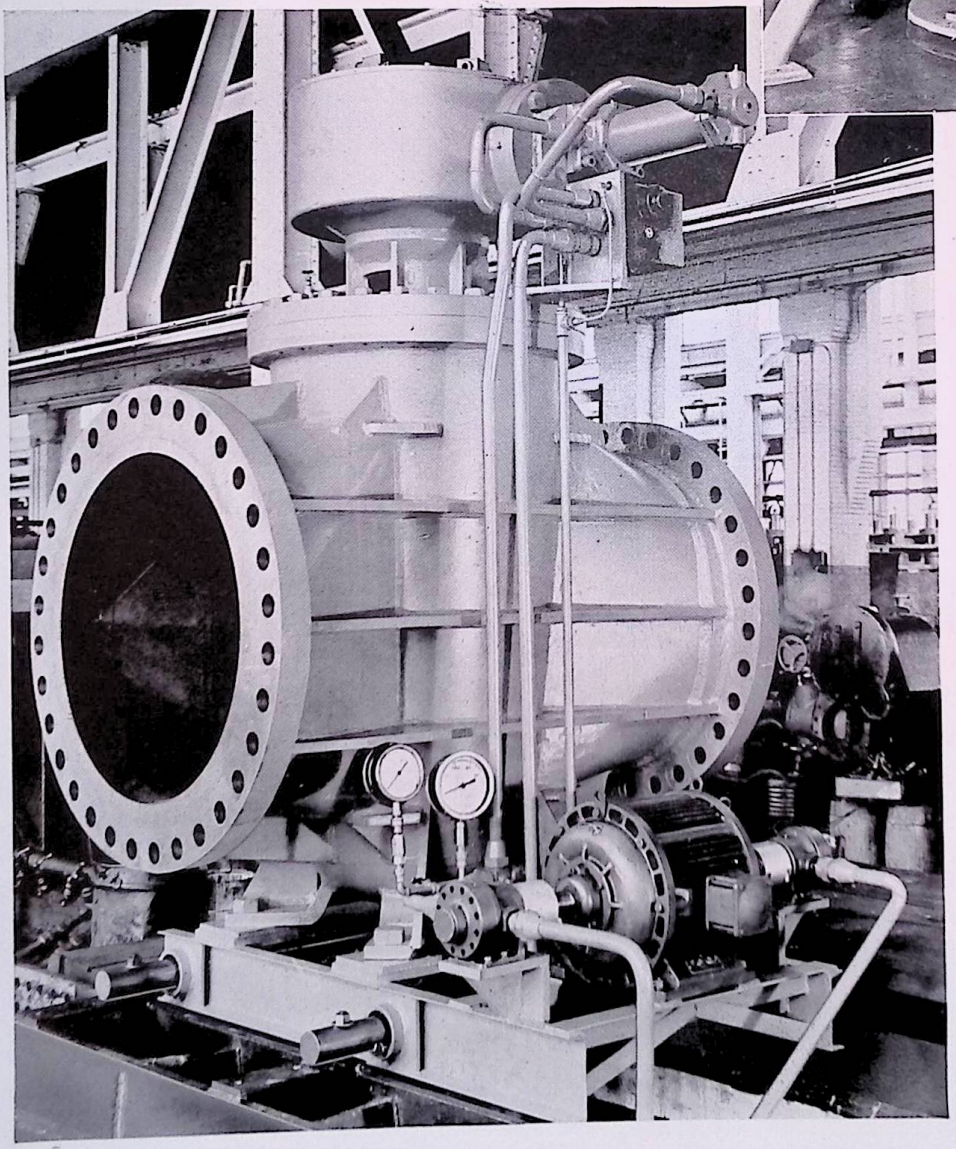
● One of a number of Rotovalves for pump check service installed by the Washington Suburban Sanitary District in their Burnt Mills Station, Hyattsville, Maryland.



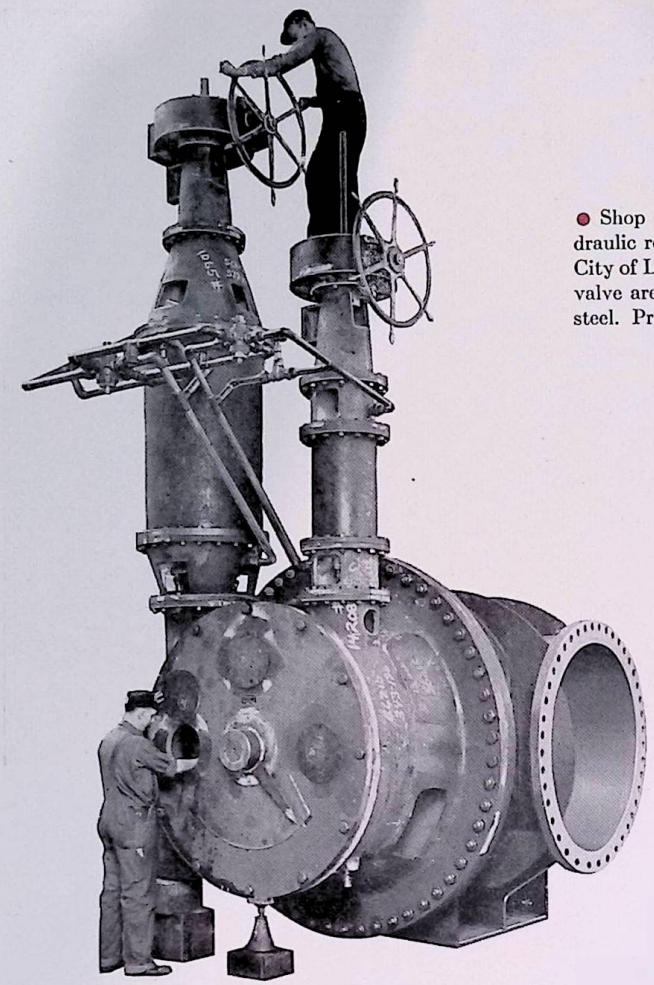
● 24-inch and 8-inch Rotovalves used in combination for pump check service with variable flow. This equipment was installed in the Quindaro Pumping Station, Kansas City, Kansas.



● One of fifteen motor-operated Rotovalves in sizes 12 to 36 inches installed for controlling air in a supersonic testing laboratory.

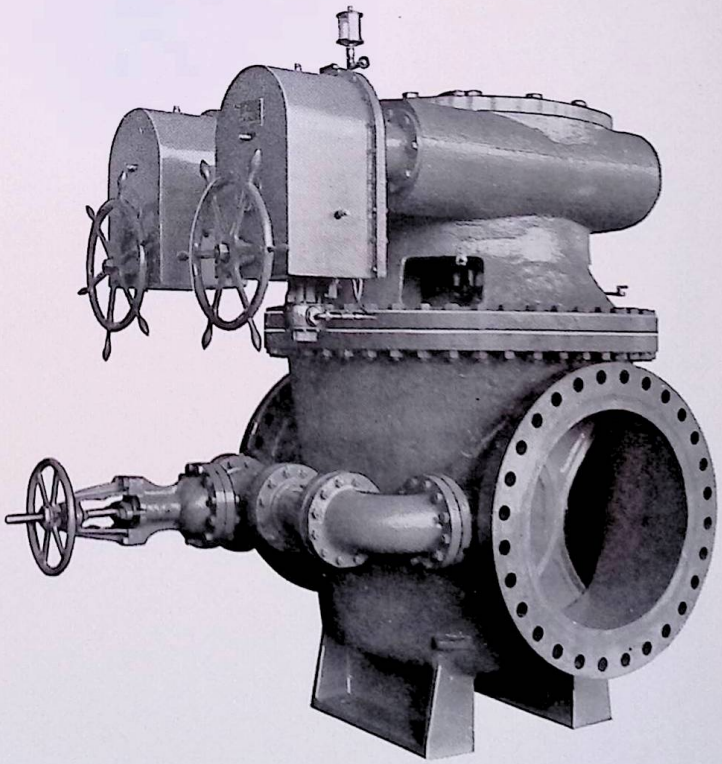


● 36-inch rectangular port welded steel pressure regulating valve for use on air release service in a ballistic laboratory. The full cycle of operation is one second!

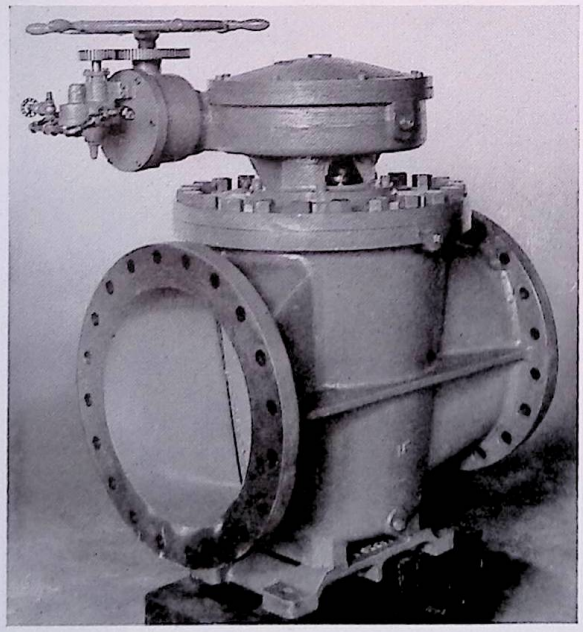


● Shop view of a 54-inch combination manual and hydraulic reseating stop valve for the Long Valley Project, City of Los Angeles, California. The body and plug of this valve are constructed of electrically welded stainless clad steel. Provision is also made for motor operation.

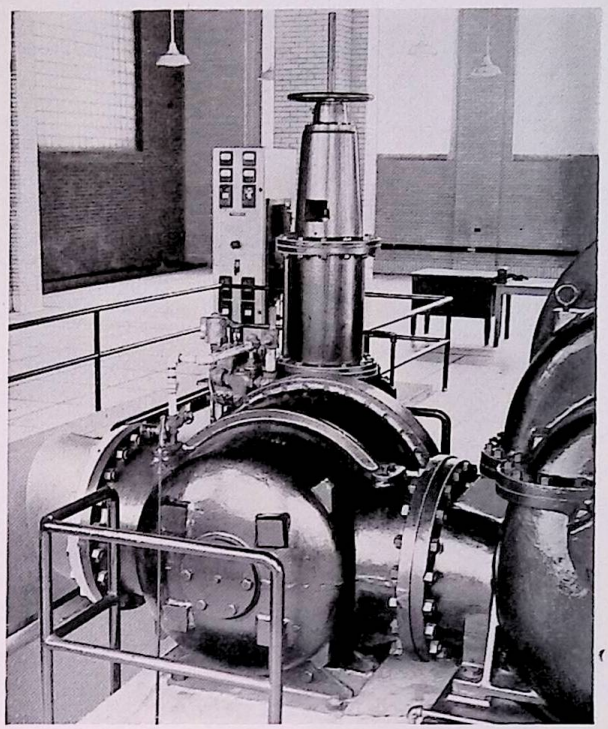
● 42-inch cast steel manual reseating Rotovalve for severe throttling service.



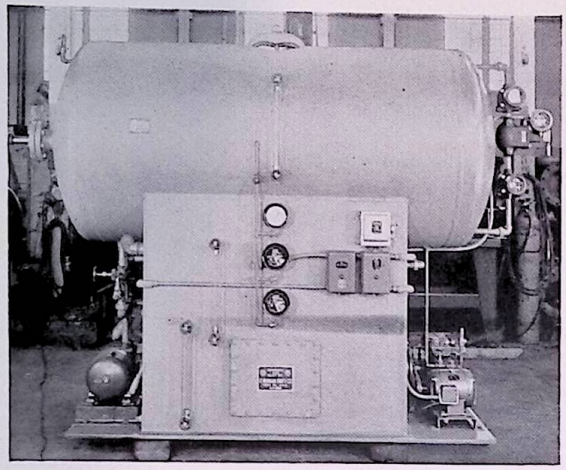
● Type "G" Rotovalve for stop service. Note the reduced area rectangular port.



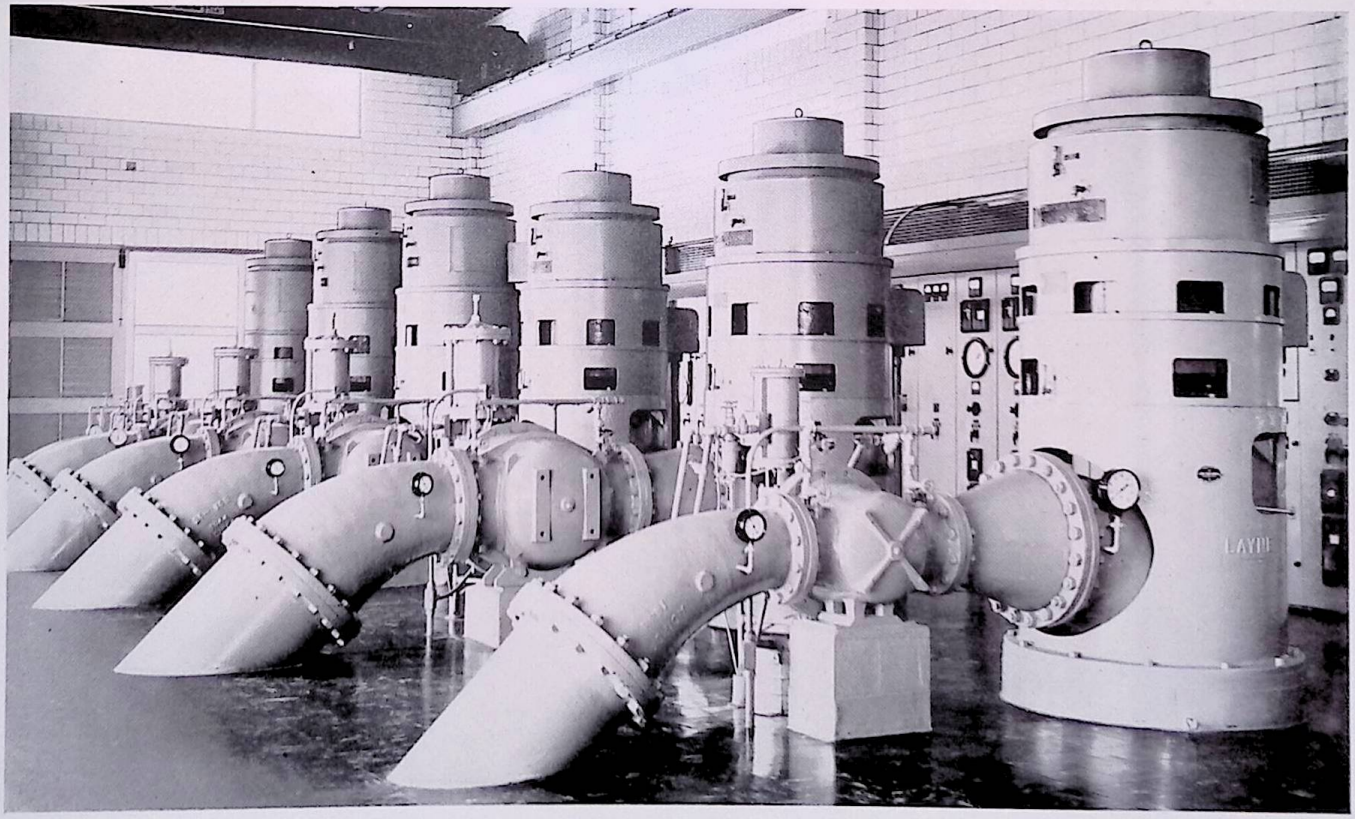
● A 24-inch Rotovalve installed for check service in the Fairmount Pumping Station, Department of Water and Heat, Cleveland, Ohio.

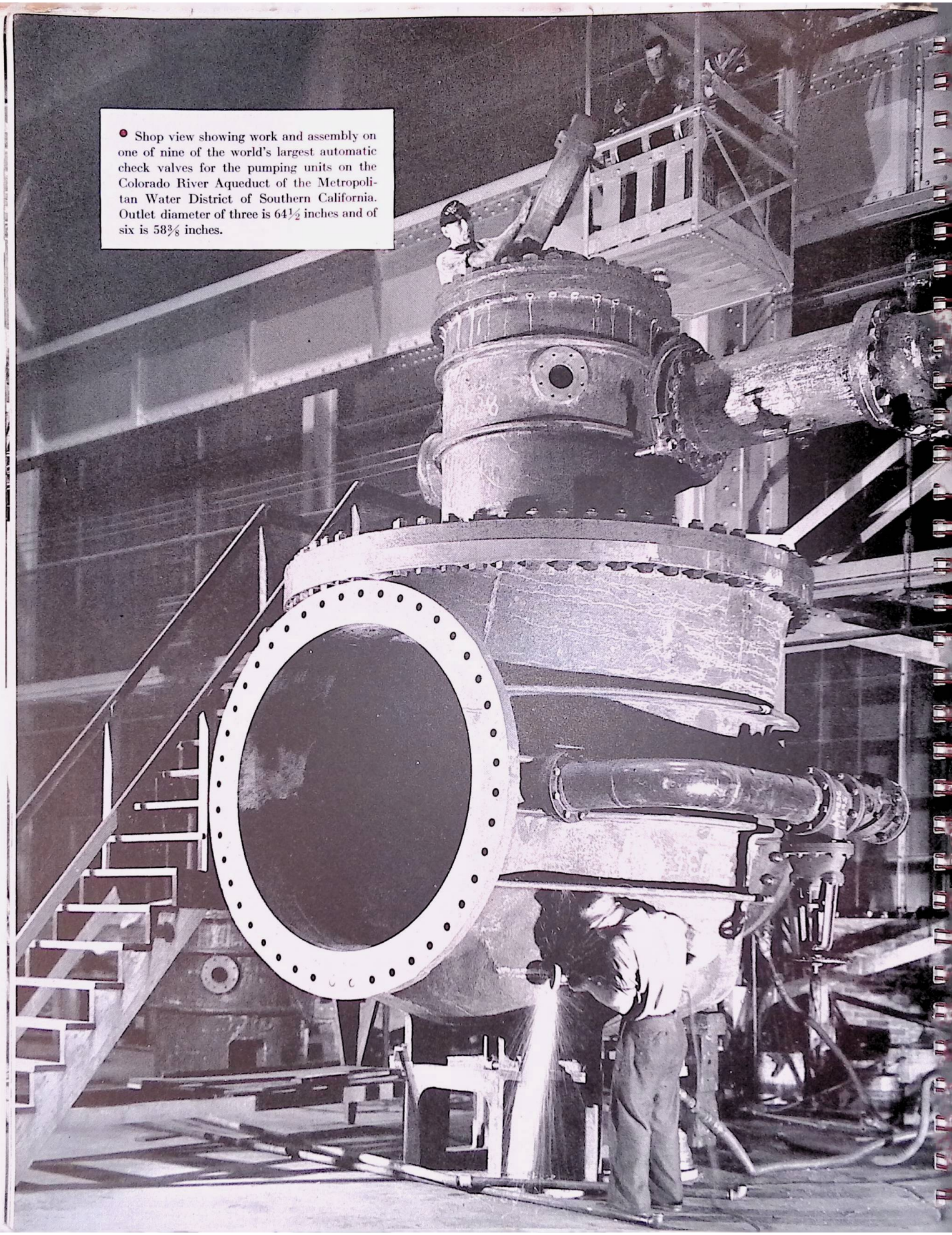


● One of a number of standard S. Morgan Smith oil Accumulator sets designed especially for valve operation.



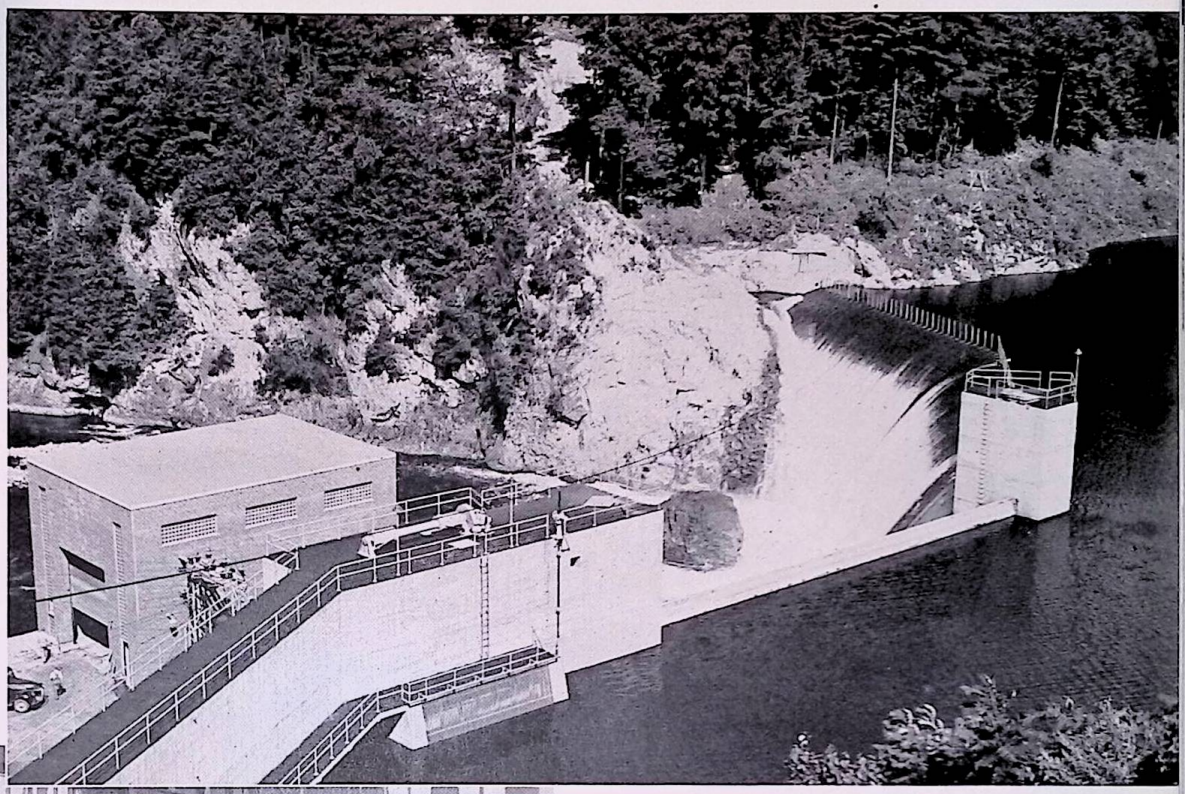
● Two 10-inch and four 16-inch hydraulically operated Rotovalves installed for check service in the Southwest Water Plant of the City of Houston, Texas.

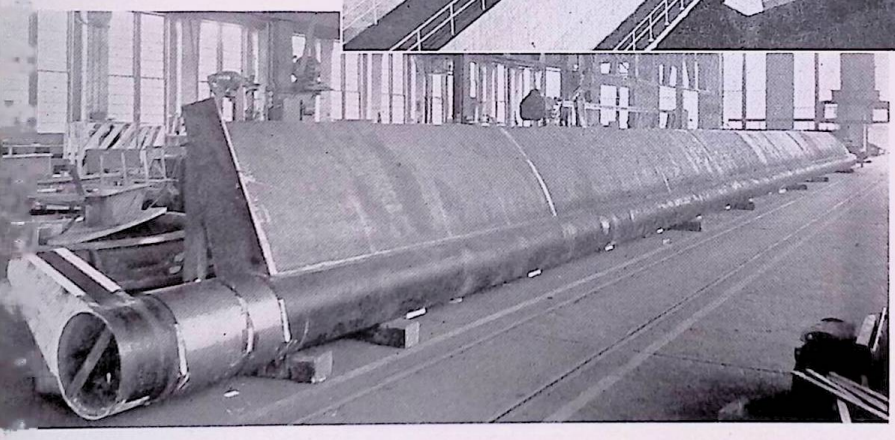




Shop view showing work and assembly on one of nine of the world's largest automatic check valves for the pumping units on the Colorado River Aqueduct of the Metropolitan Water District of Southern California. Outlet diameter of three is 64½ inches and of six is 58⅜ inches.

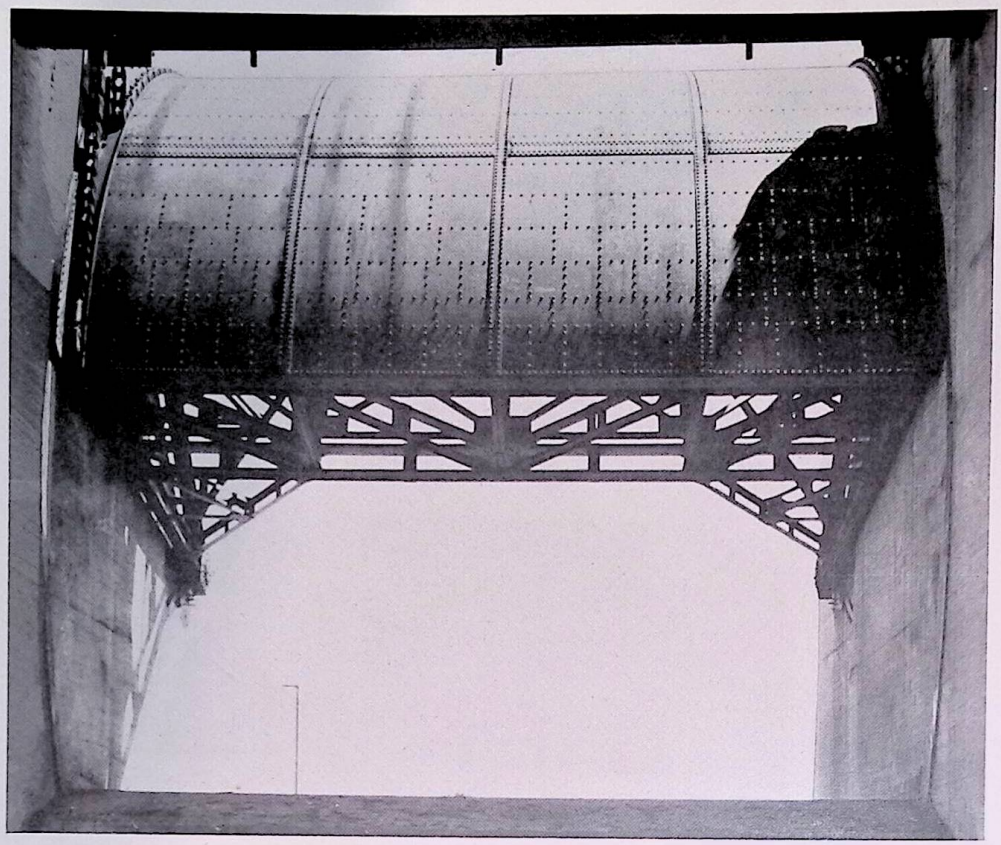
GATES and HOISTS





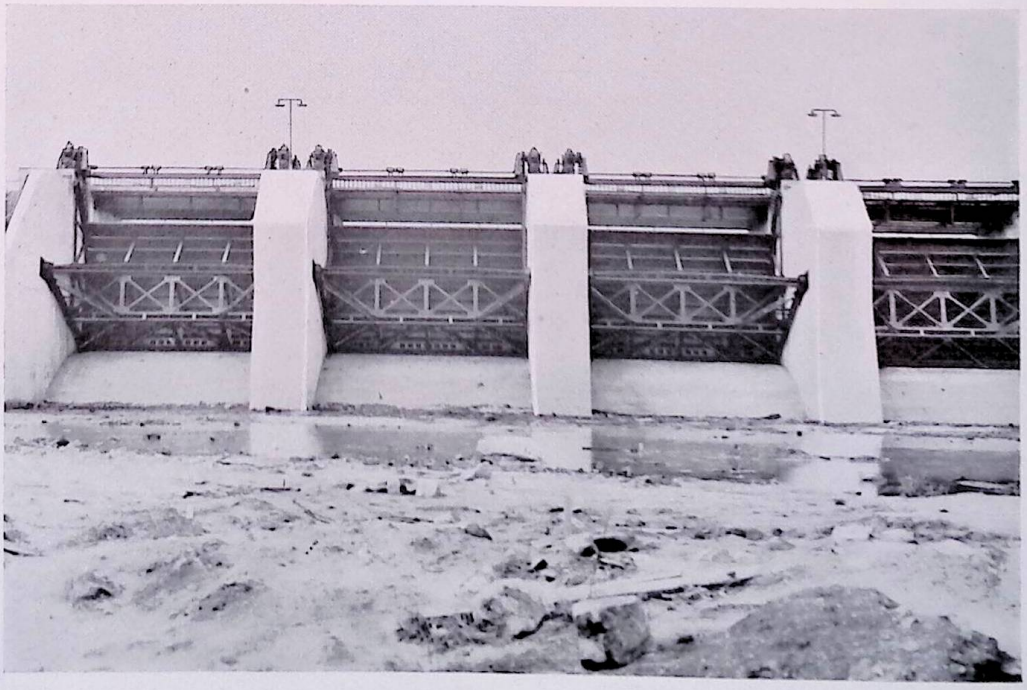
● Public Electric Light Co., Woods Falls Station, St. Albans, Vermont, is equipped with a 6 x 98-foot Bascule Crest Gate with automatic float control, as pictured. To the left of it is a Smith double-drum, 75,000 pounds capacity, chain hoist for the Smith 14 foot wide by 16 foot high, fixed wheel head gate. A Smith-Kaplan turbine, which develops 8100 H.P. at 55 feet head, completes this very modern power station.

● 3 foot x 100-foot Bascule Gate made for Commonwealth of Massachusetts, Starrett Dam. This modern Smith gate installed on a concrete dam, is hydraulically operated and maintains the pool level by float control. Such gates will pass large quantities of ice and floating debris. They have been designed in sizes up to 10 x 100 feet.



● The Radial Gate is supported at each end by trunnions and may be operated by either chain or cable hoists.

● S. MORGAN SMITH COMPANY has built and installed many Radial or "Taintor" Gates. Some installations utilize both Radial and Roller Gates, where the Roller Gates are specifically intended to meet severe ice conditions, or to provide long spillways and reduce the number of piers to a minimum.

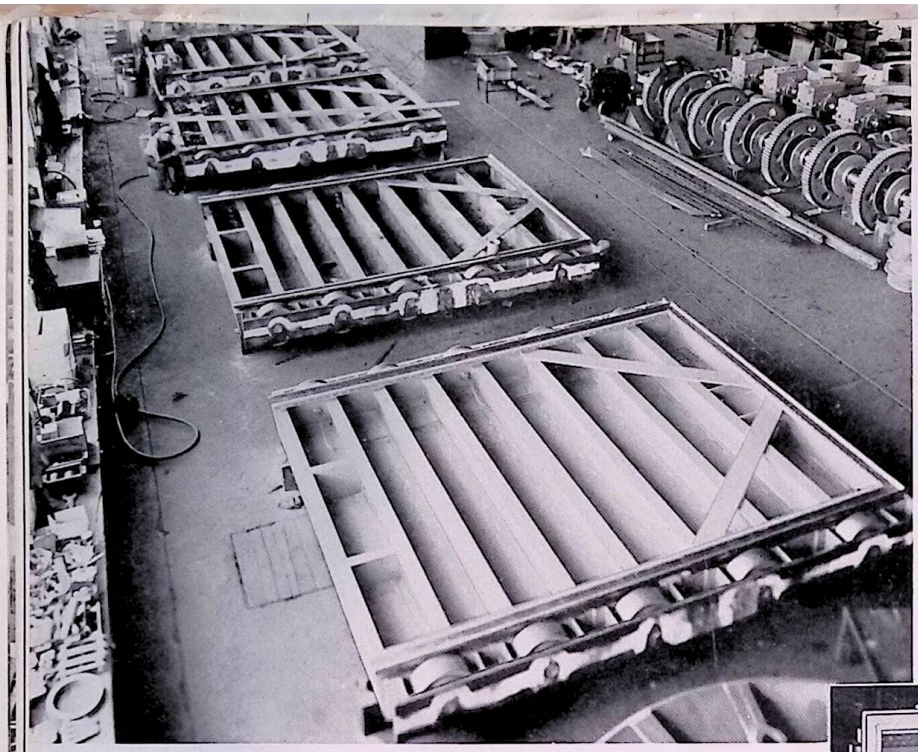


● Four Smith Radial Gates, each 37 feet 8 inches between piers, and 25 feet high, installed for the Lexington Water Power Company, in the Saluda River, South Carolina.

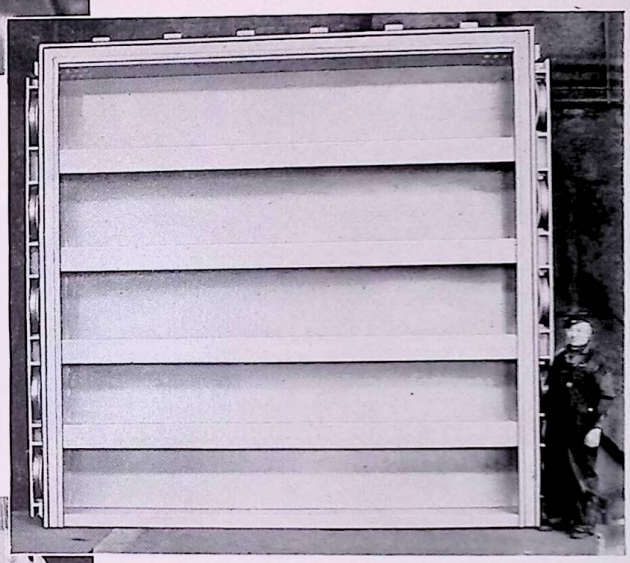
● Dam 15, on the Mississippi River between Rock Island, Illinois, and Davenport, Iowa. Eleven Smith Roller Gates are installed, nine being 100 feet long between piers, with a damming height of 26 feet. Two gates, one at either end, are 100 feet long between piers with a damming height, from crest of dam to crest of gate, of 21 feet.

● Gate 115 feet long between piers with 18 feet damming height, in partly open position, made for the New England Power Company, being installed at Bellows Falls, Vermont, in the Connecticut River.

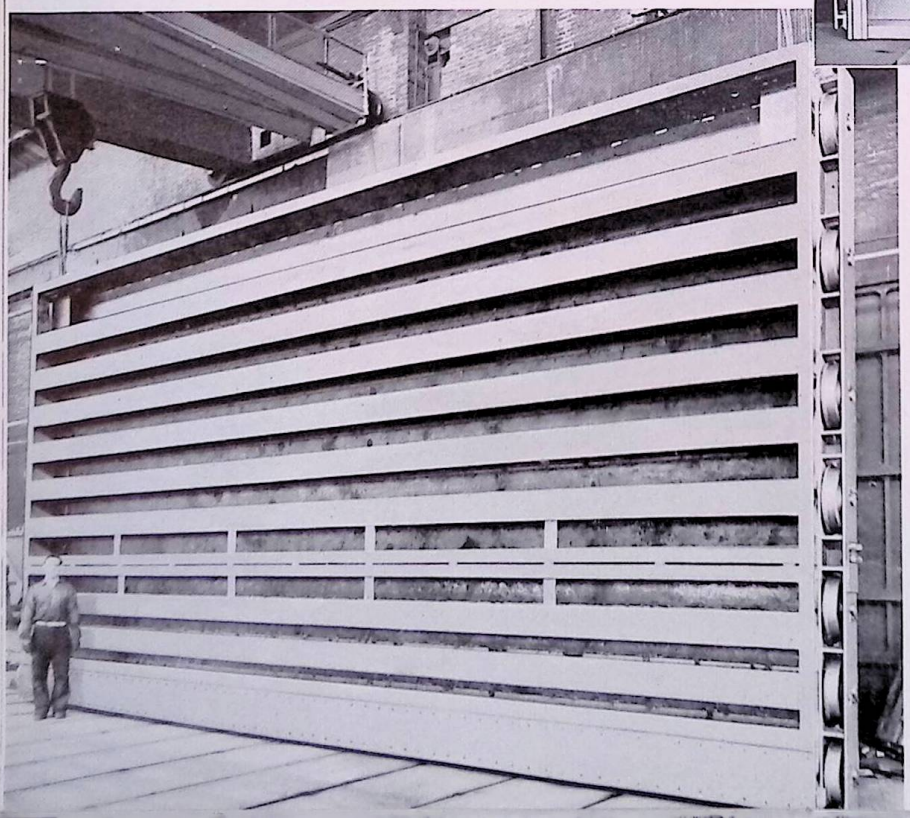
● Below: View of an unexpected and sudden break-up, after ice had piled nearly 5 feet high above the Roller Gates. All three gates were raised to full open position, without difficulty, and passed at Lewiston, Idaho, some 40 miles of ice in the record time of less than 10 hours.



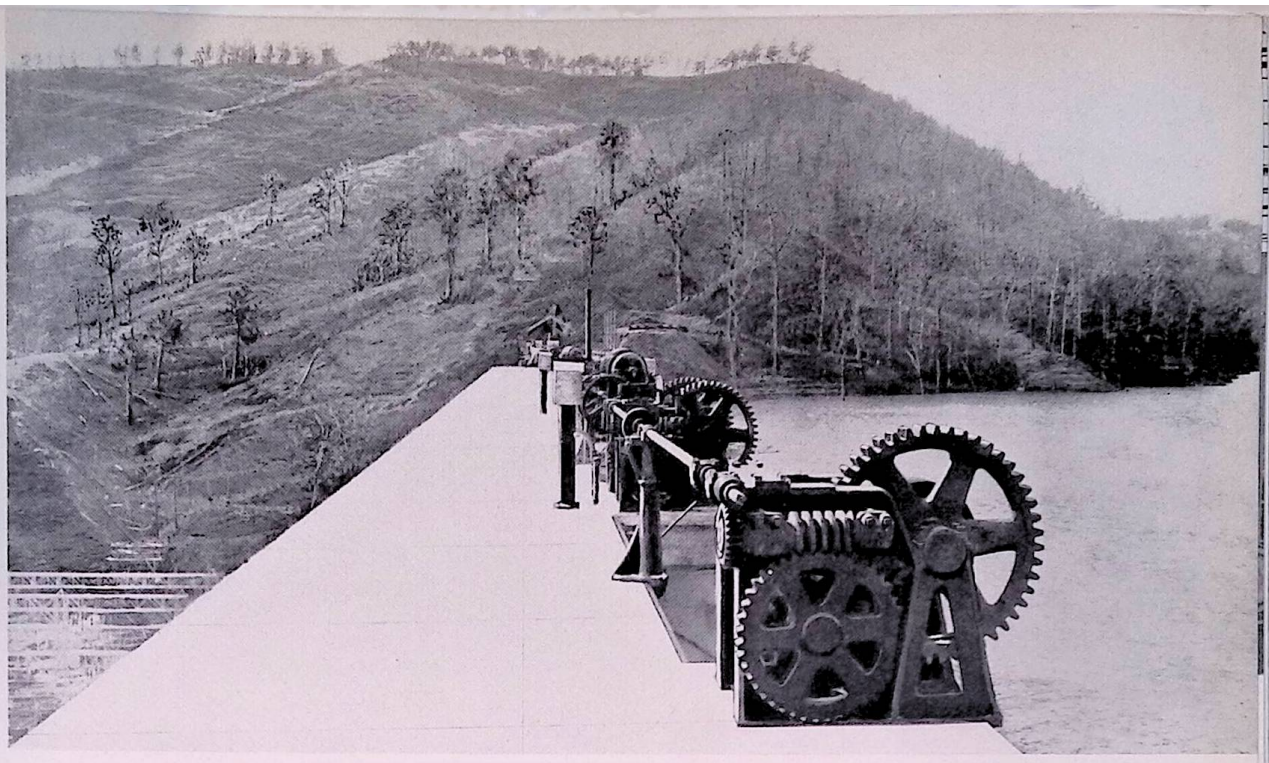
● 12 x 16-foot fixed wheel gates made for the Great Northern Paper Company.



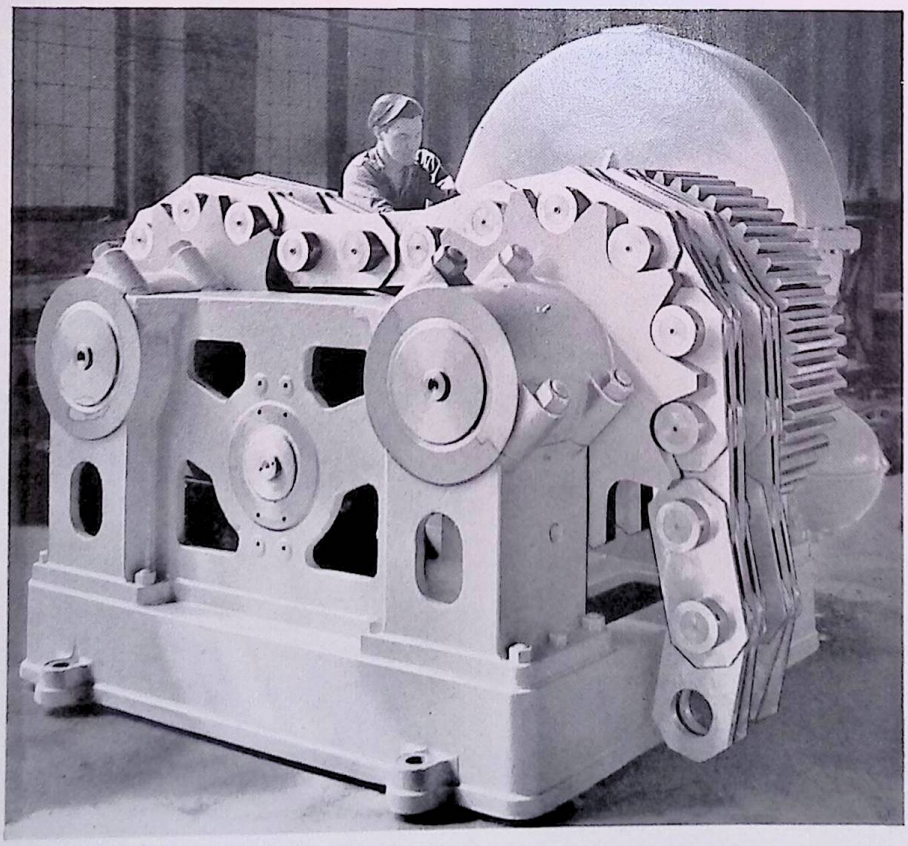
● Gate of the fixed wheel type built in Smith's Welding Department, illustrates an ability to meet any and all types of gate-construction demands.



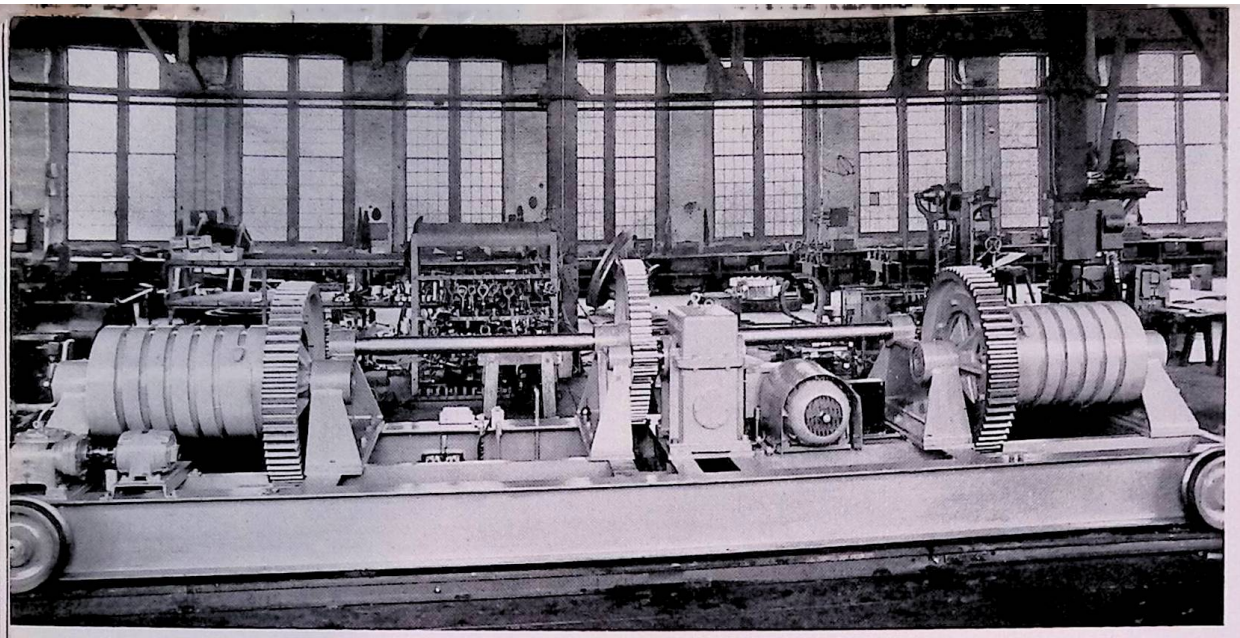
● Fixed wheel crest gate ready for shipment, completely assembled in the Smith shops.



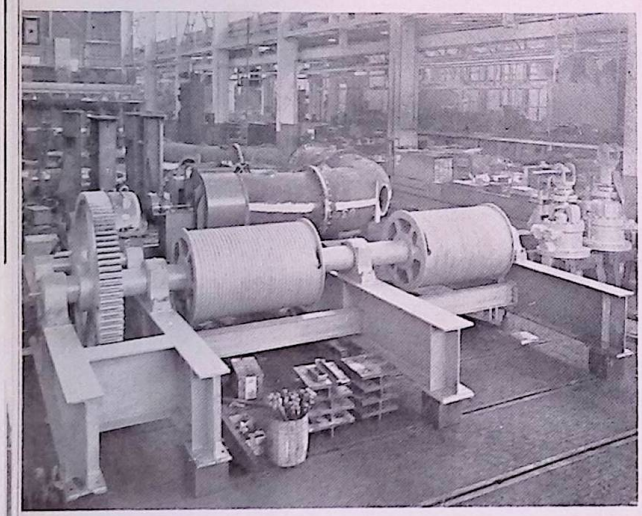
● Ruggedness, reliability and simplicity of design characterize these Crest Gate Hoists.



● A chain and sprocket hoist for exacting standards of an unusual installation. Note the fine Smith workmanship on this massive hoist.

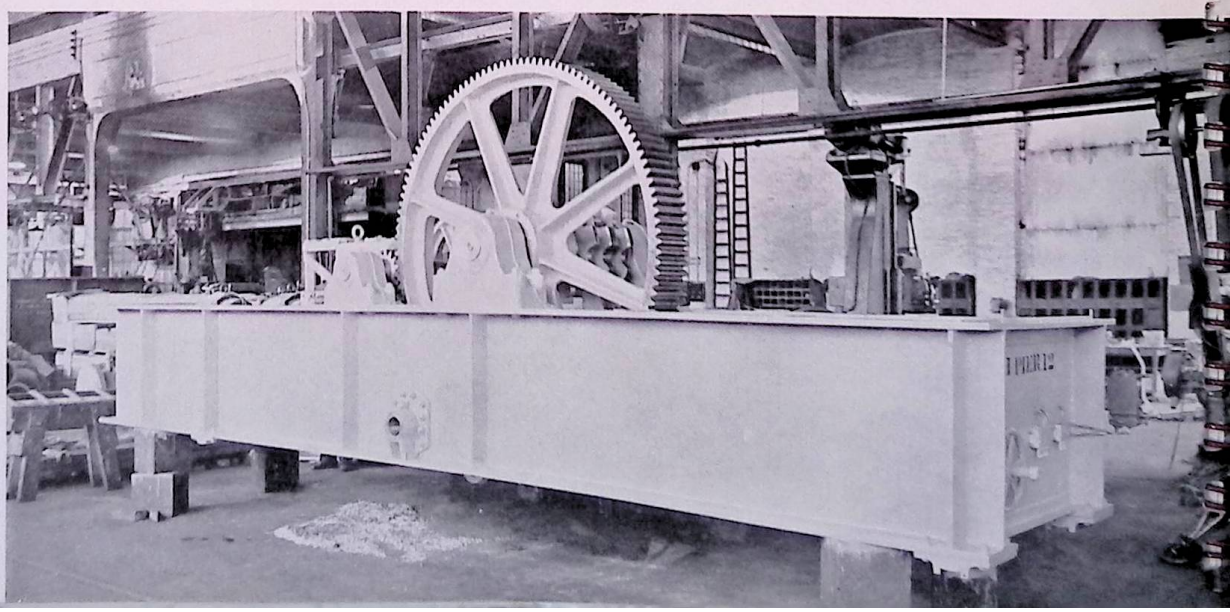


● A high capacity traveling chain hoist.

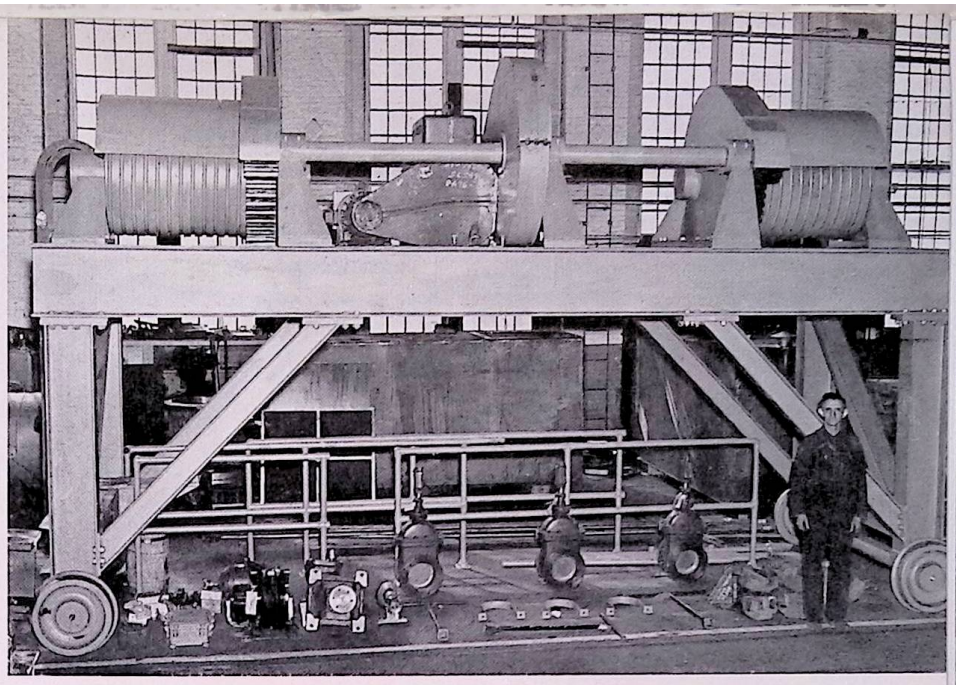


● Central Hidroelectrica Del Rio Anchicaya, Cali, Colombia. 150,000-pound capacity (75,000 pounds each cable) cable and drum hoist for raising 20 feet 6 inch x 21-foot wide fixed wheel type gate. Electric motor drive with auxiliary gasoline motor. Air fan brake.

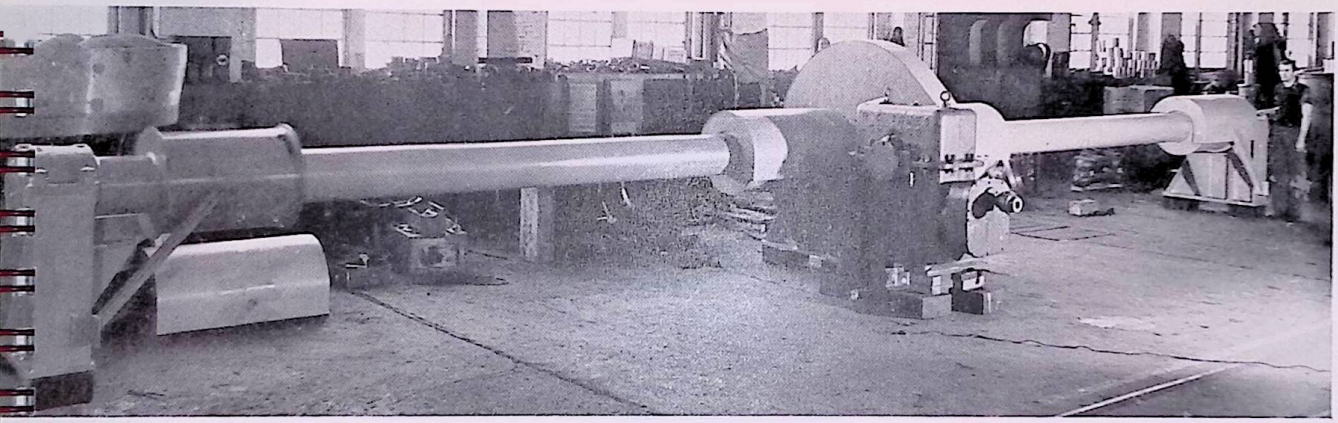
● Shop view of one of twenty-eight 75,000-pound capacity chain and sprocket hoists for operating fourteen 12 foot high x 100 foot long direct lift gates for the U.S. Engineers, Emsworth Lock and Dam.

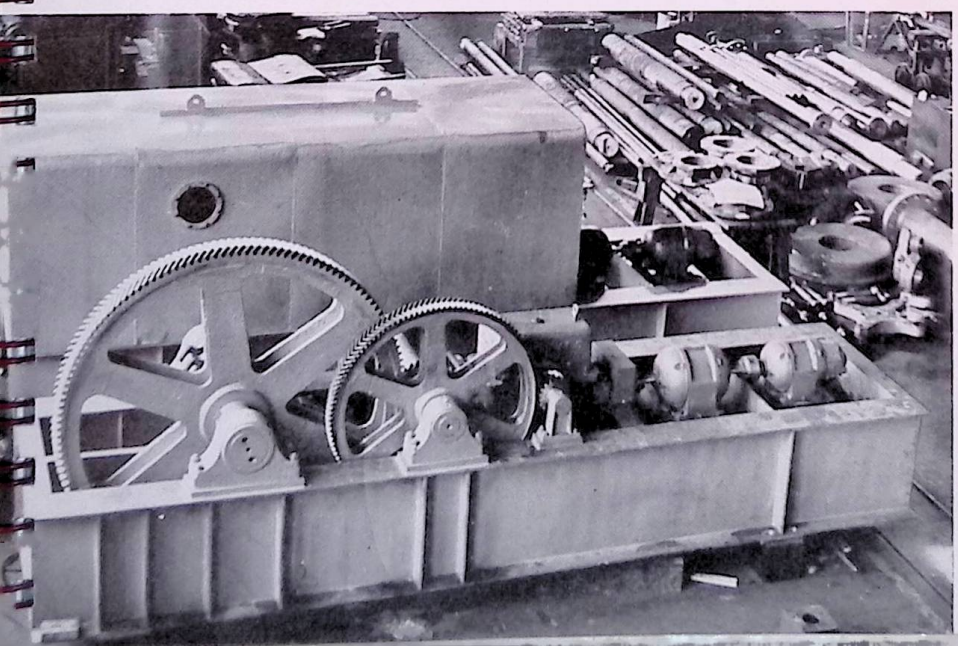


● 40,000-pound capacity traveling gate hoist, of the chain and drum type, as built for Saltos Del Duero, Spain, Villalcampo Plant.

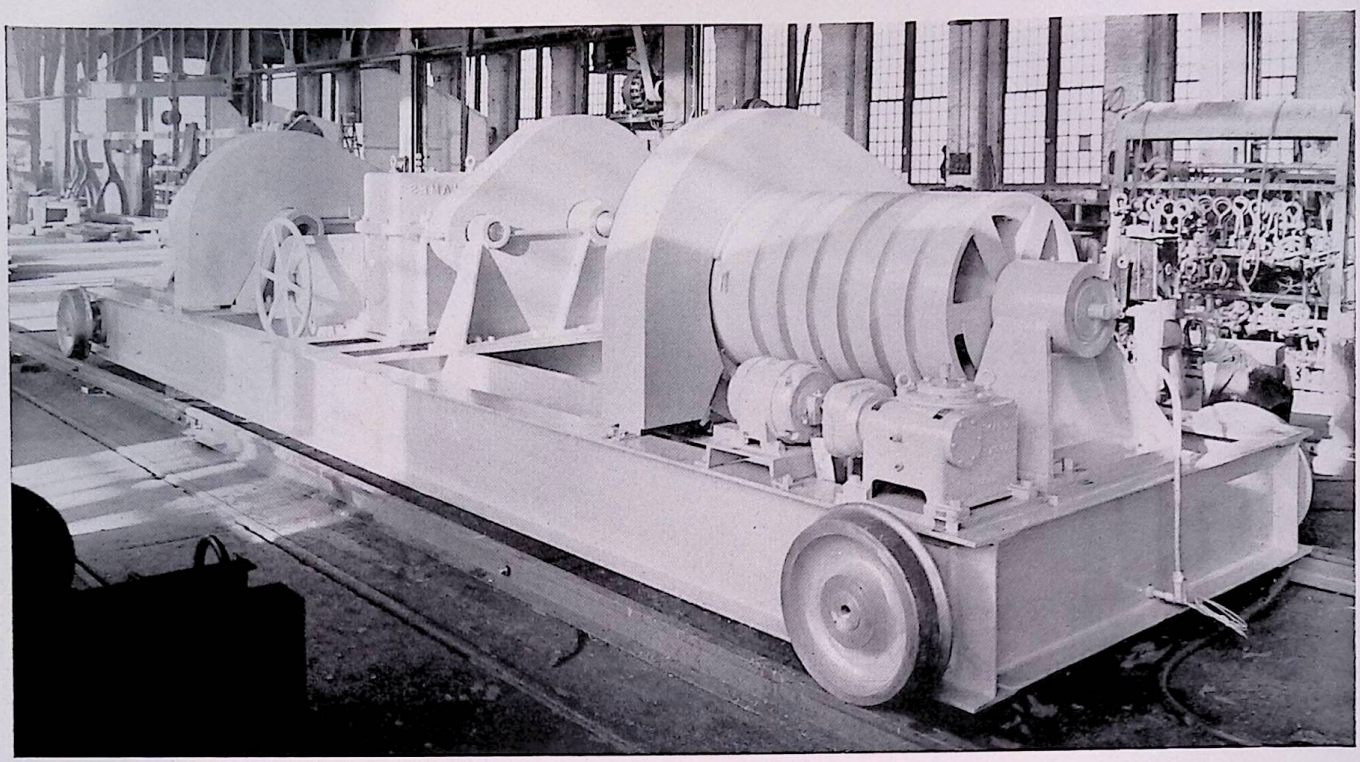


● 60,000-pound capacity chain and drum type hoist built for installation in the above Plant.





● Two of eight 175,000-pound capacity hoists, of the chain and sprocket type, for raising the four 78-foot wide and 38-foot high radial gates installed in the Villalcampo Plant.

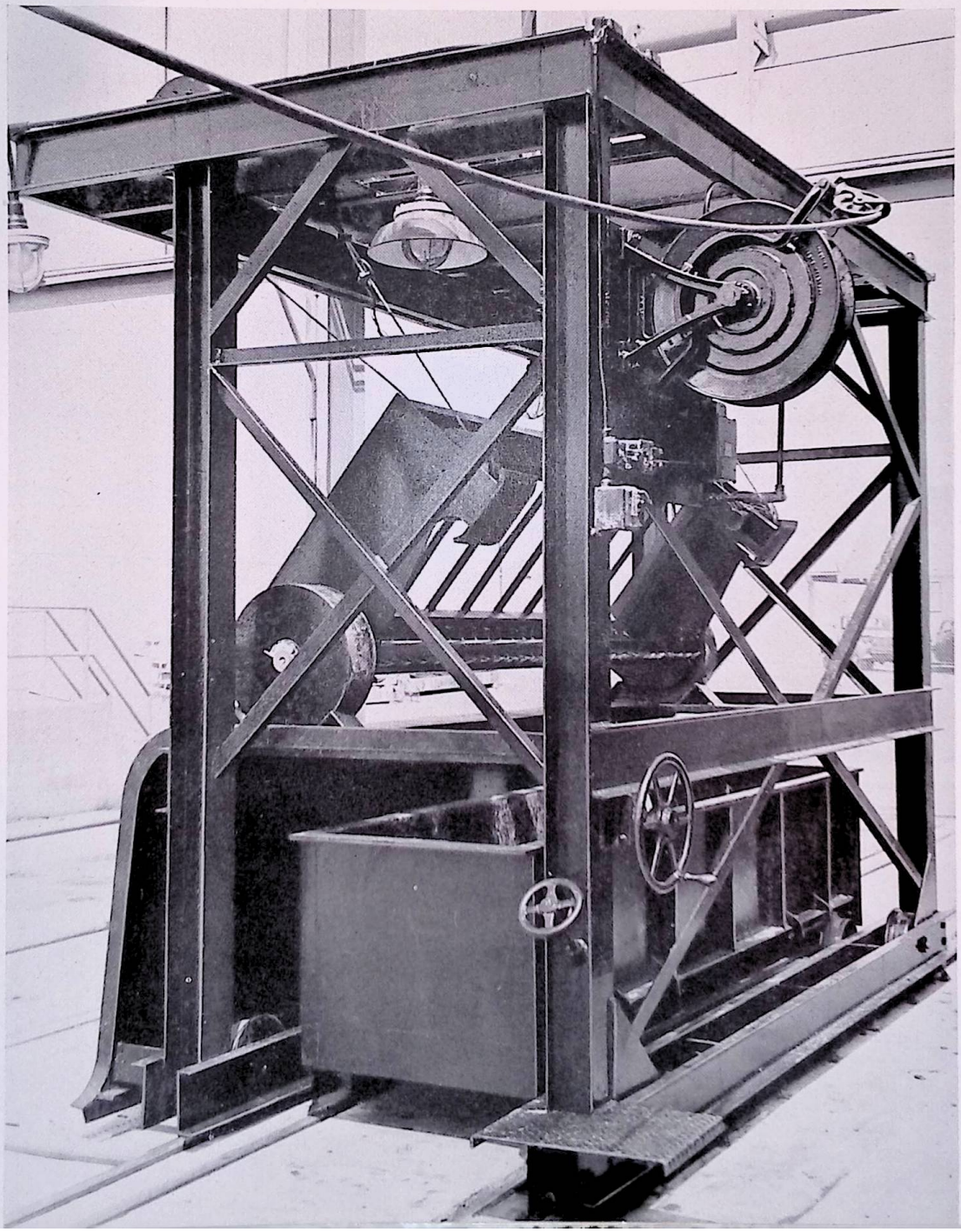


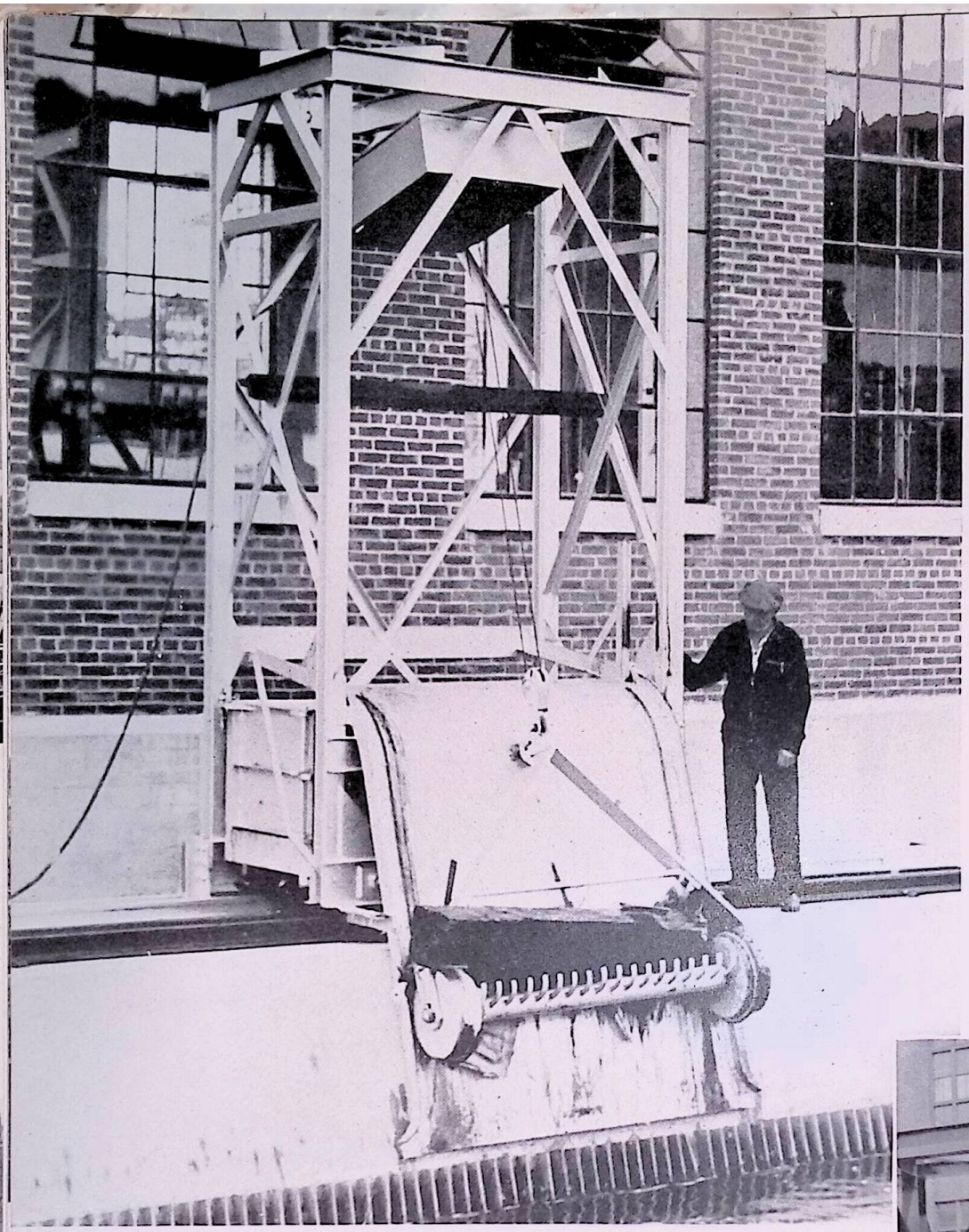
● 100,000-pound capacity chain and drum type hoist assembled and ready for shipment to Lower Colorado River Authority, Austin Dam.

● Roller Gate in partly open position; disturbance downstream is due to baffles installed on the dam to dissipate the energy of the water.

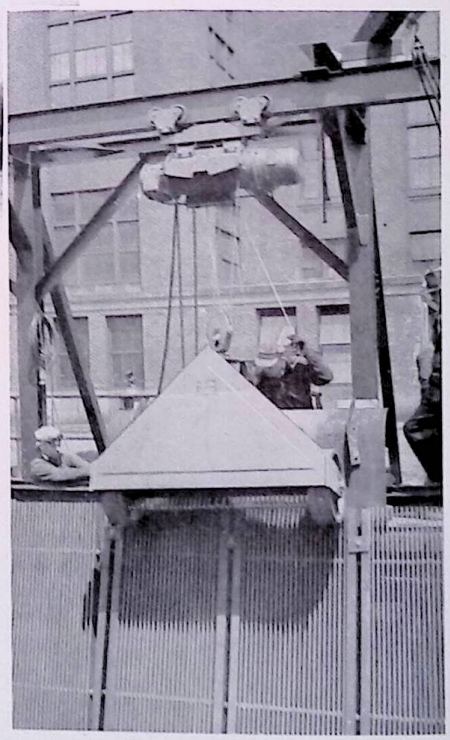
TRASH RACK RAKES

● Leonard trash raking unit servicing the coarse screens for the condenser circulating water intake system at the Redondo Steam Station of the Southern California Edison Company, Redondo Beach, California.

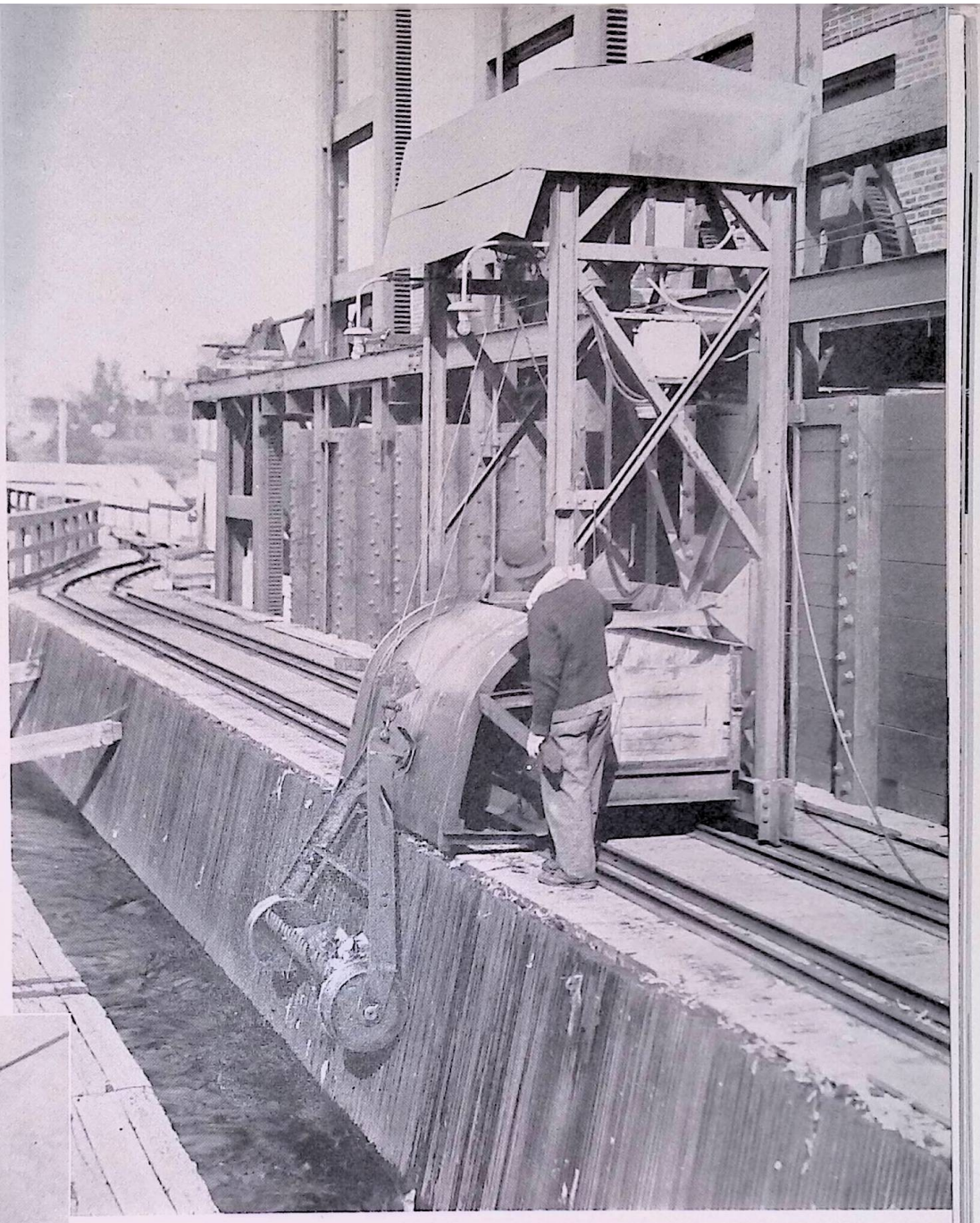




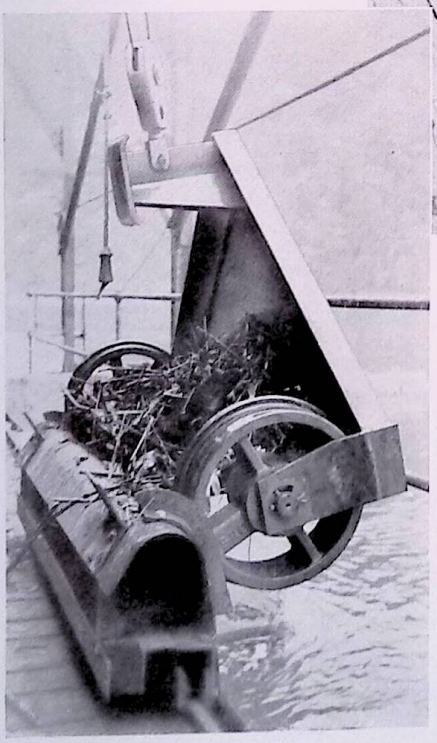
● Leonard Trash Rake at the Veasie Plant of the Bangor Hydro-Electric Company.



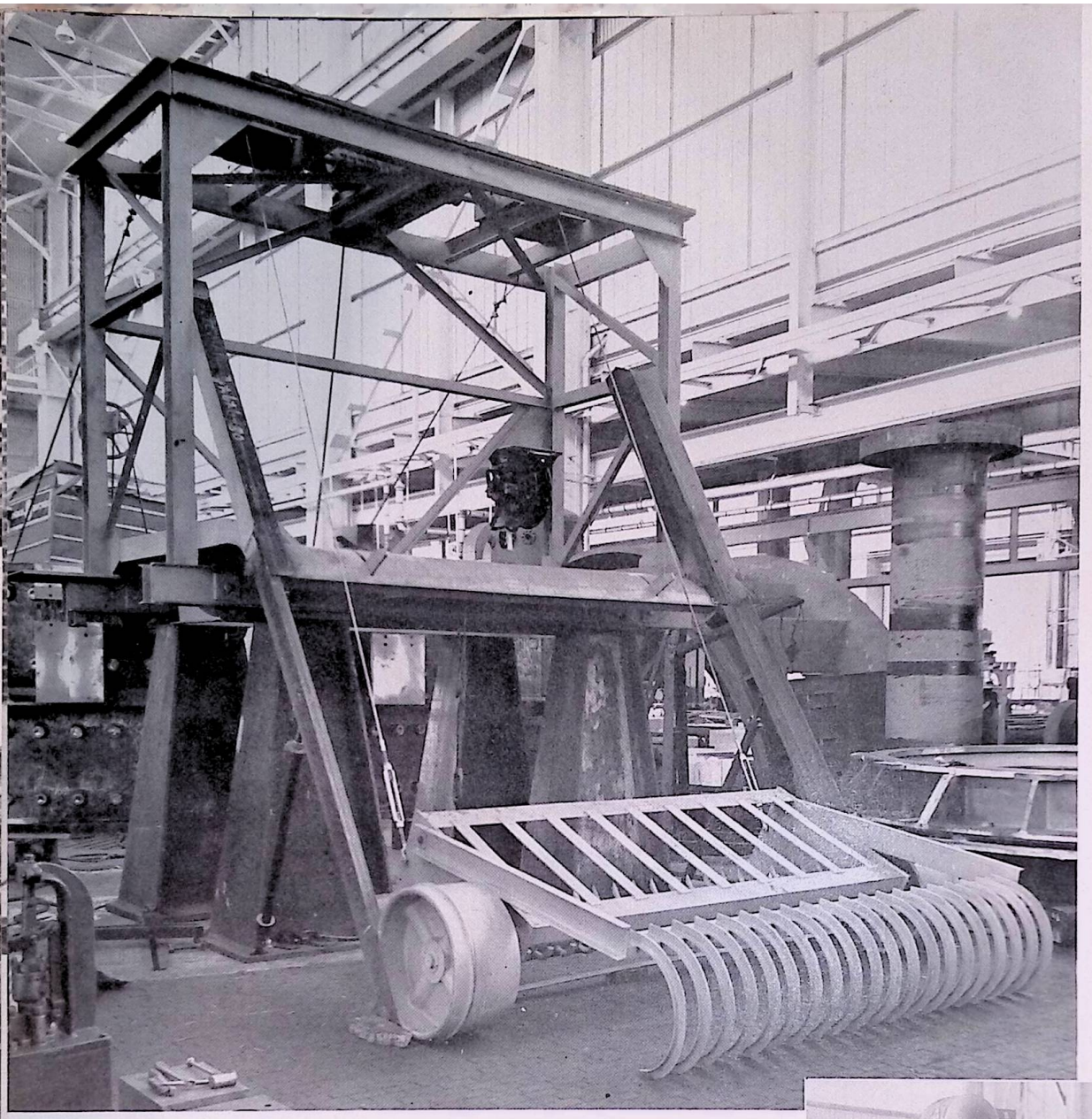
● View of Leonard raking unit with monorail hoist at the Saxton Steam Plant of the Pennsylvania Edison Company.



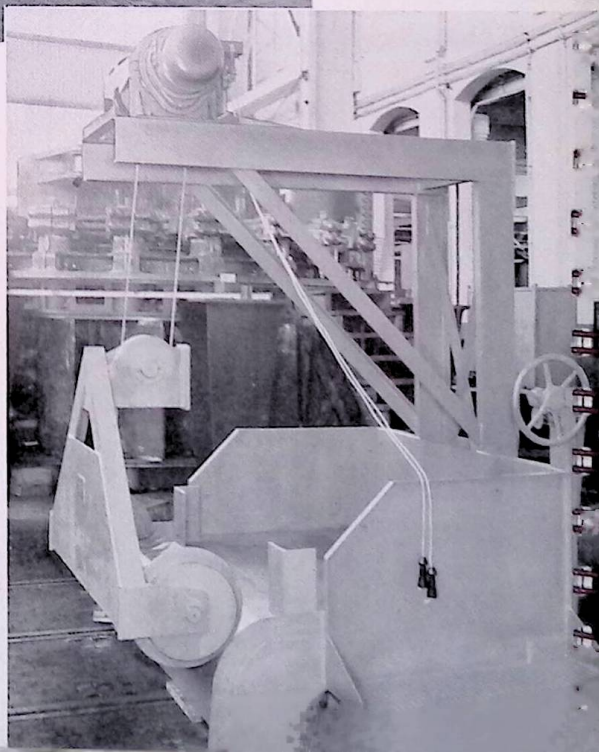
● Installation view of Leonard unit at the Great Works Plant of the Penobscot Chemical Fibre Company.



● Leonard Trash Rake in operation at the Warrior's Ridge Plant of the Pennsylvania Edison Company, Petersburg, Pennsylvania.



● Leonard Trash Rack Rake with special removable bottom cleaning attachment for long river grass, for Upper Salmon Plant of Idaho Power Company.

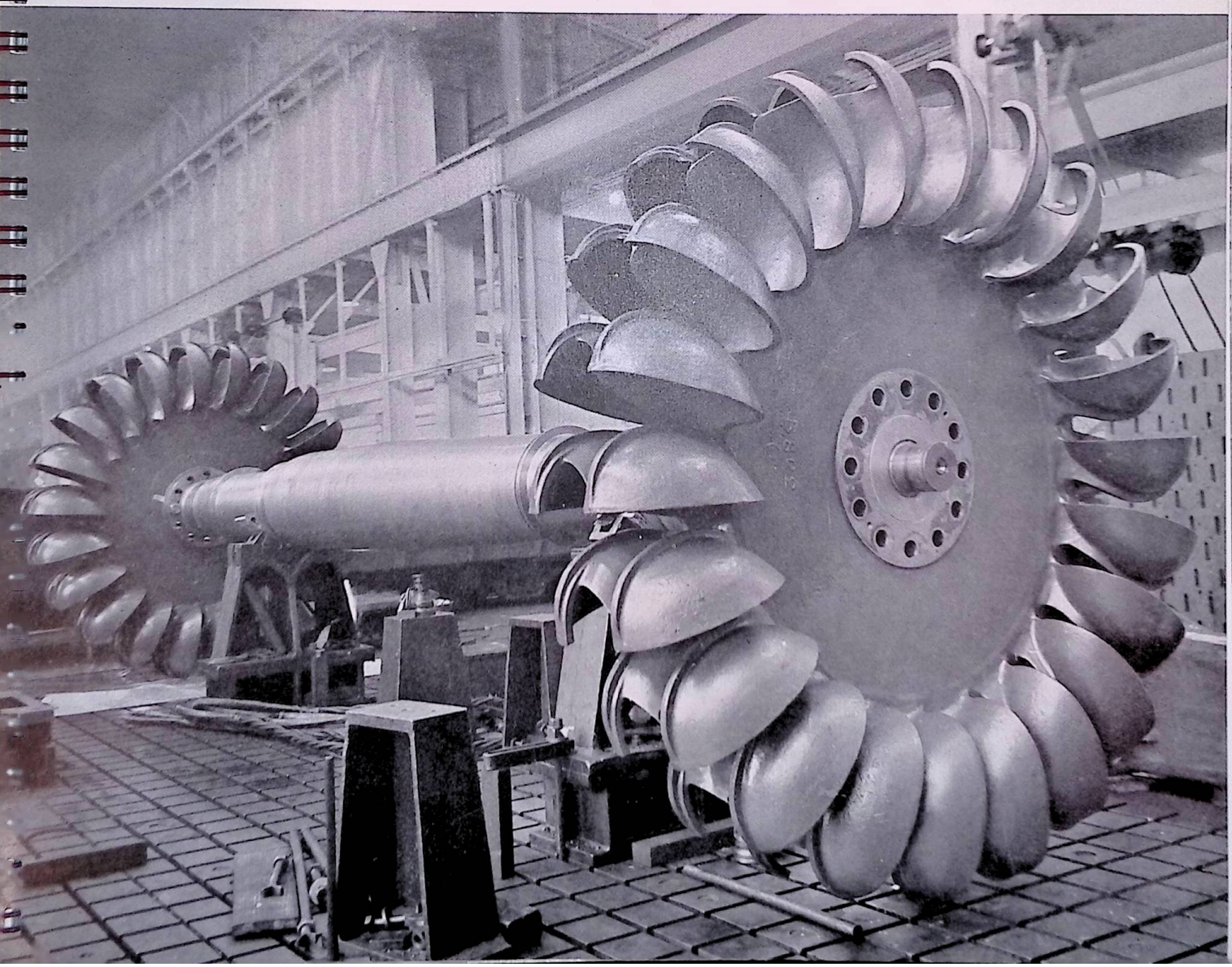


● Leonard raking unit for the Chesterfield Plant of the Virginia Electric and Power Company.

IMPULSE Turbines

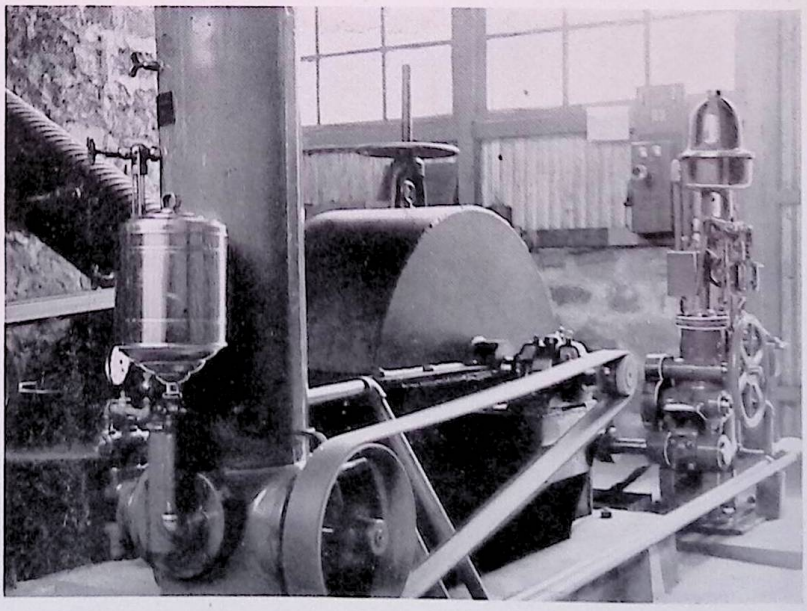
IMPULSE Turbines are utilized where the quantity of water in relation to the head is relatively small, and where the head is considered too high for Francis turbines.

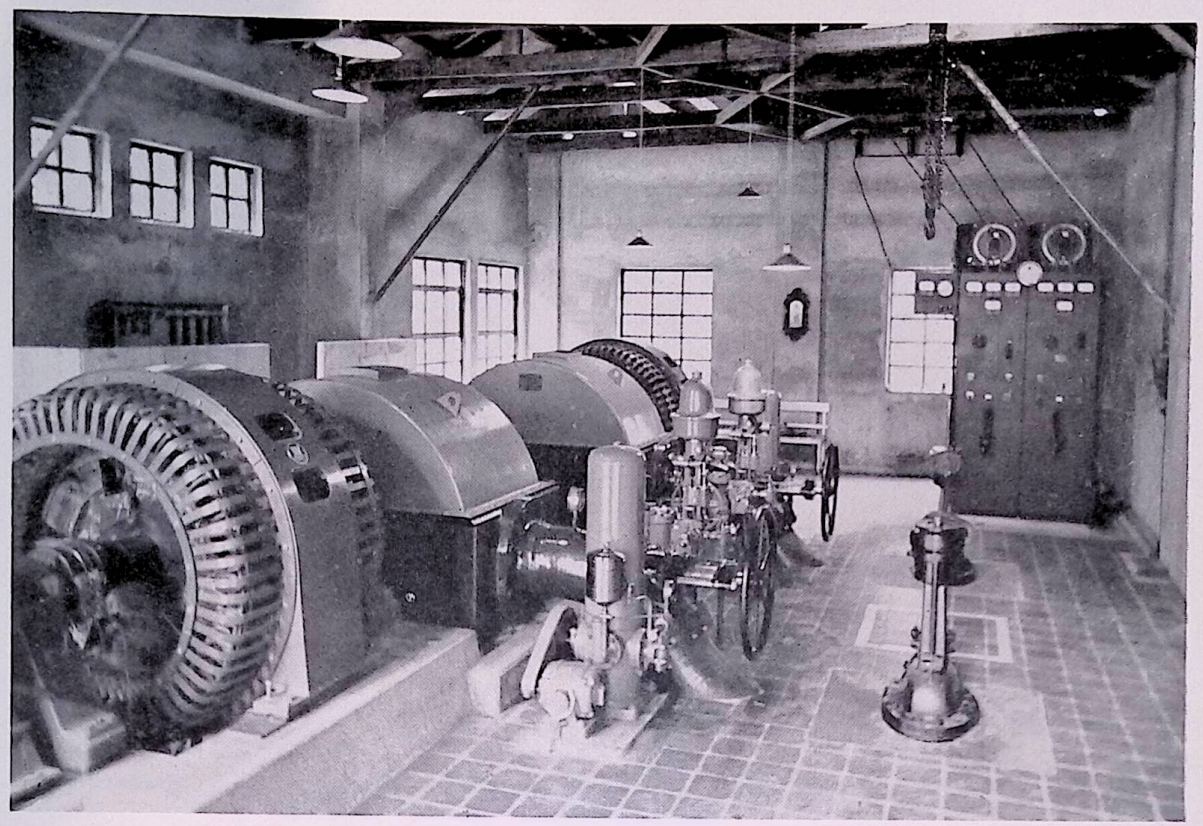
● Shop assembly of the Volcan runners and unit shaft, installed in Chile, rated 17,750 H.P. under a head of 575.6 feet at a speed of 231 R.P.M. The generator is located between the runners, which have a maximum diameter of 9 feet 7 inches.



● Exterior of plant in Andes Mountains, Bolivia. Note extreme ruggedness of the terrain.

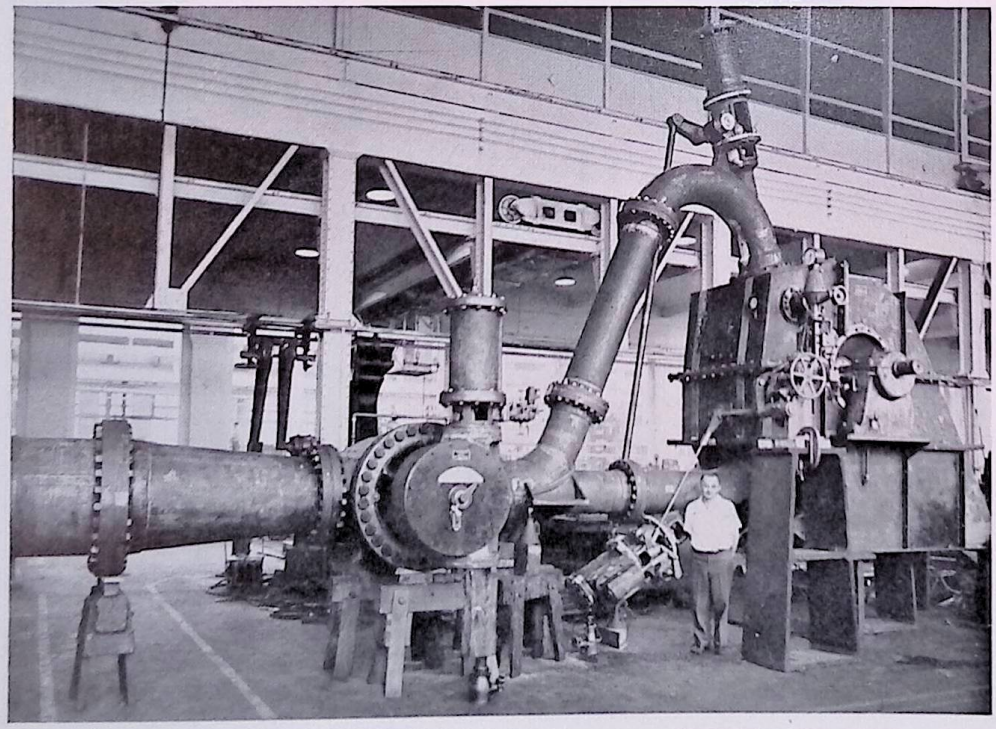
● Interior of above plant, containing 103 H.P. Smith Impulse turbine. Head 200 feet, speed 637 R.P.M. The turbine is connected to the generator through V belts.

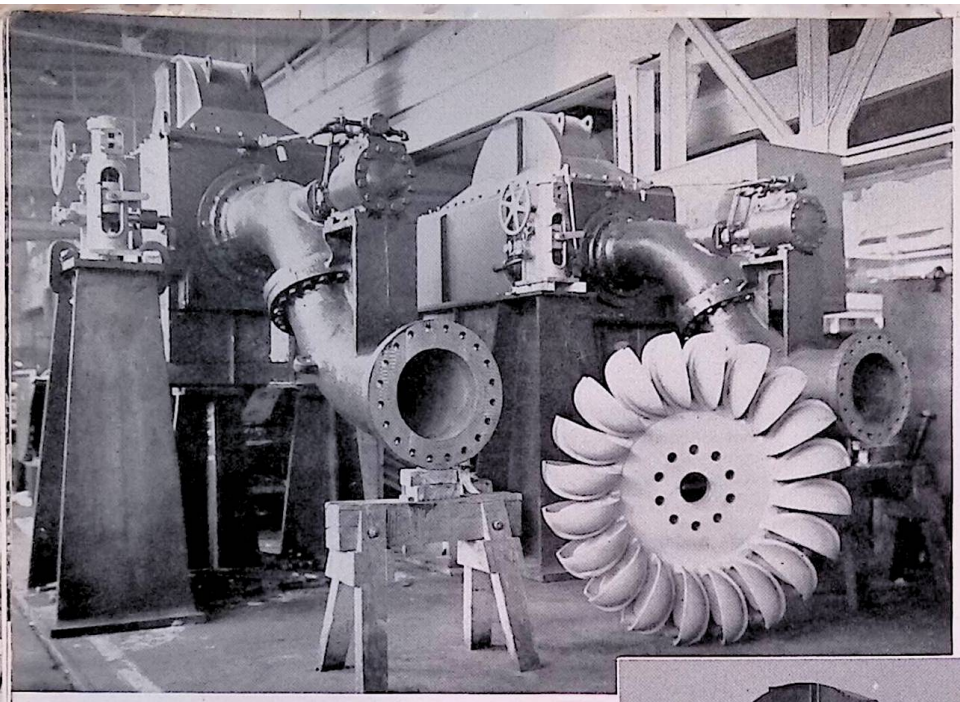




● Interior view of Julio Bravo Plant of Empresa de Energia Electrica, Colombia, S.A., in which two 725 H.P. Smith turbines are installed, under head of 459 feet, and speed of 720 R.P.M.

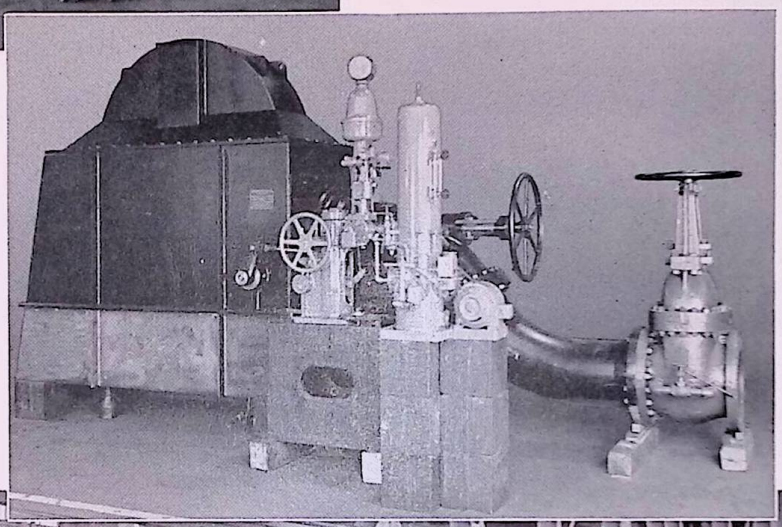
● Turbine installed in the Michelet Power Plant of La Societe des Forces Motrices d'Algerie, Algiers, Africa, under 1072 feet head, developing 4000 H.P. at 750 R.P.M. Note the hydraulic Rotovalve for inlet service.



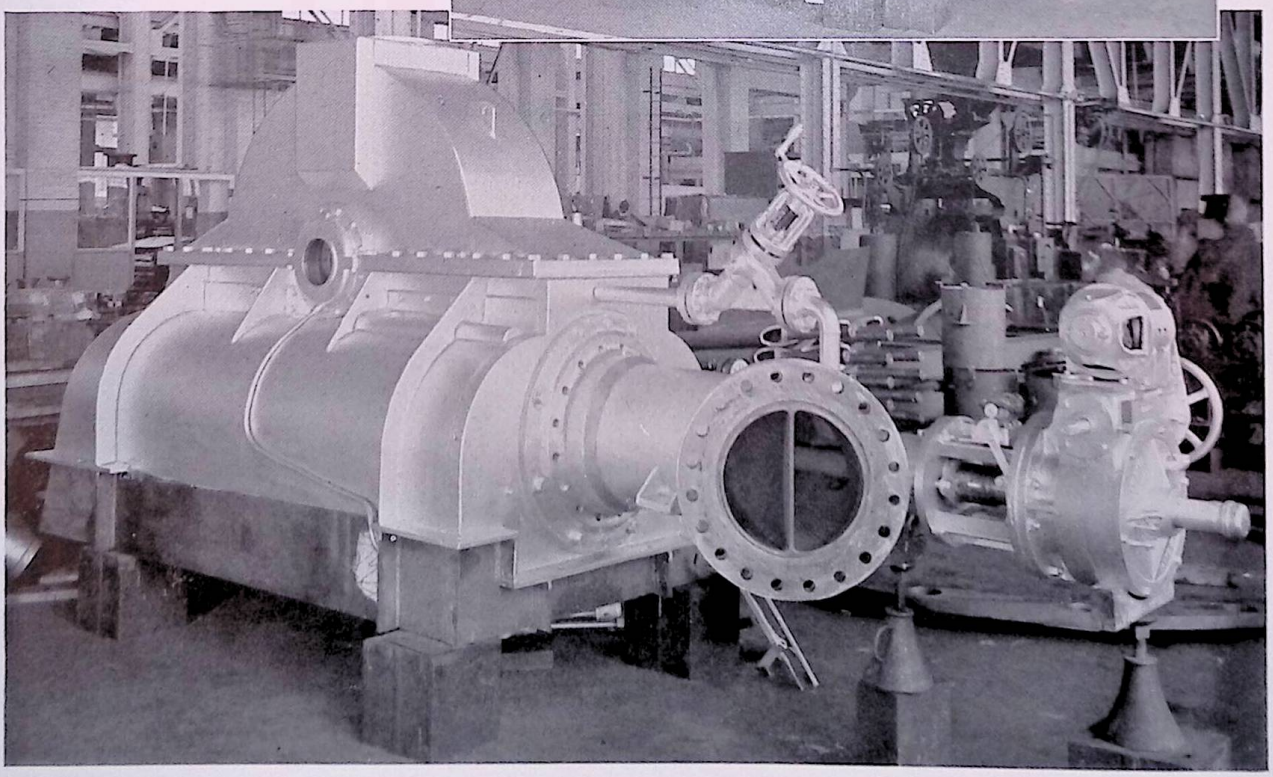


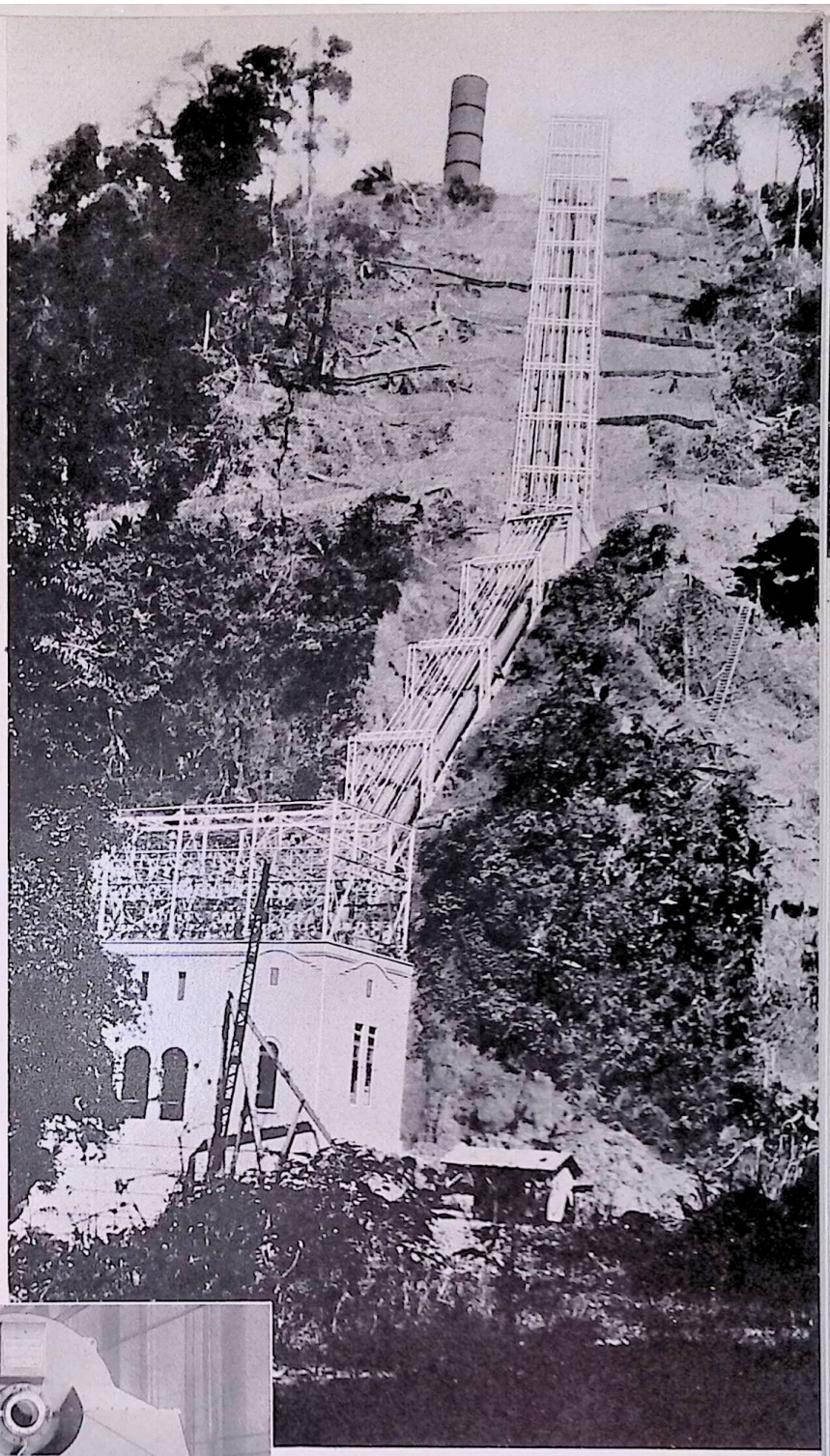
● Two 2930 H.P. Smith Impulse units for installation in Brazil. Head 973 feet, speed 600 R.P.M. These machines were purchased by Companhia Sul Mineira de Electricidade for installation in their Poco Fundo Plant. The governors control both the jets and the deflectors.

● Right: View of 1150 H.P. turbine for Cerro de Pasco Copper Co., Chile. Head 497 feet, speed 360 R.P.M. Governor controls deflector only.



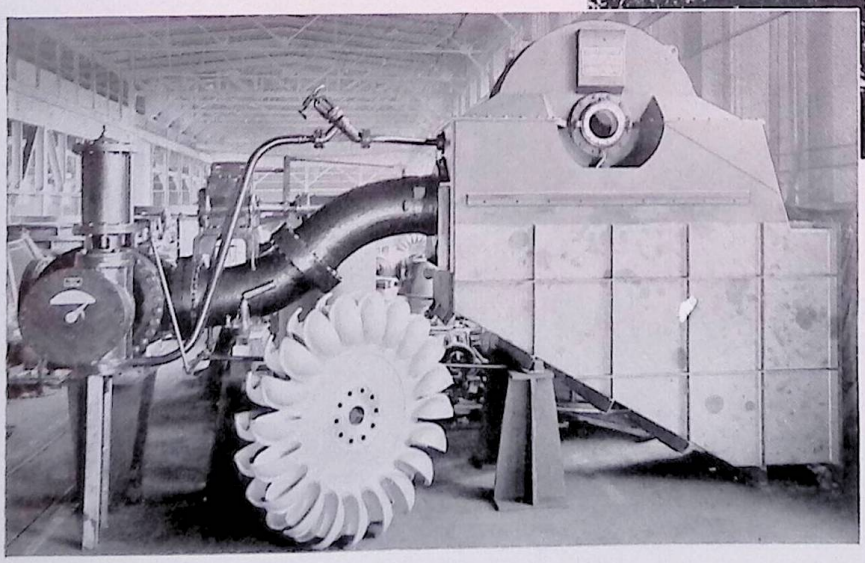
● Below: 2250 H.P. turbine for Nantahala Power and Light Co., North Carolina. Head 935 feet, speed 600 R.P.M. Motor operated needle controlled from switchboard in nearby station.

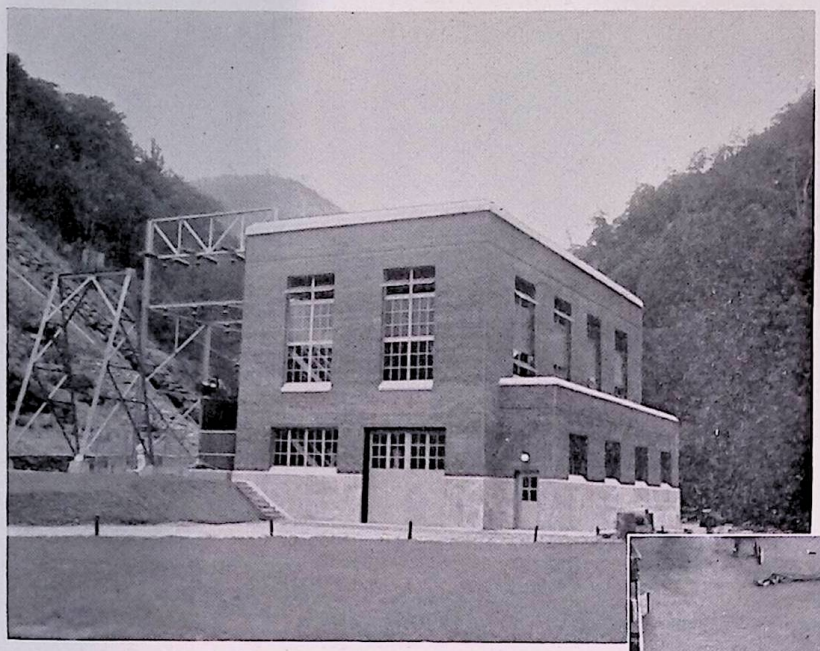




● View of the Botocan Plant of the Manila Electric Company, Philippine Islands. One 1200 H.P. Smith Impulse and two Smith-Francis Turbines of 11,000 H.P. capacity each operate under 600 feet head. The units in this plant were seriously damaged as the result of enemy action during the recent War and have since been rebuilt by us.

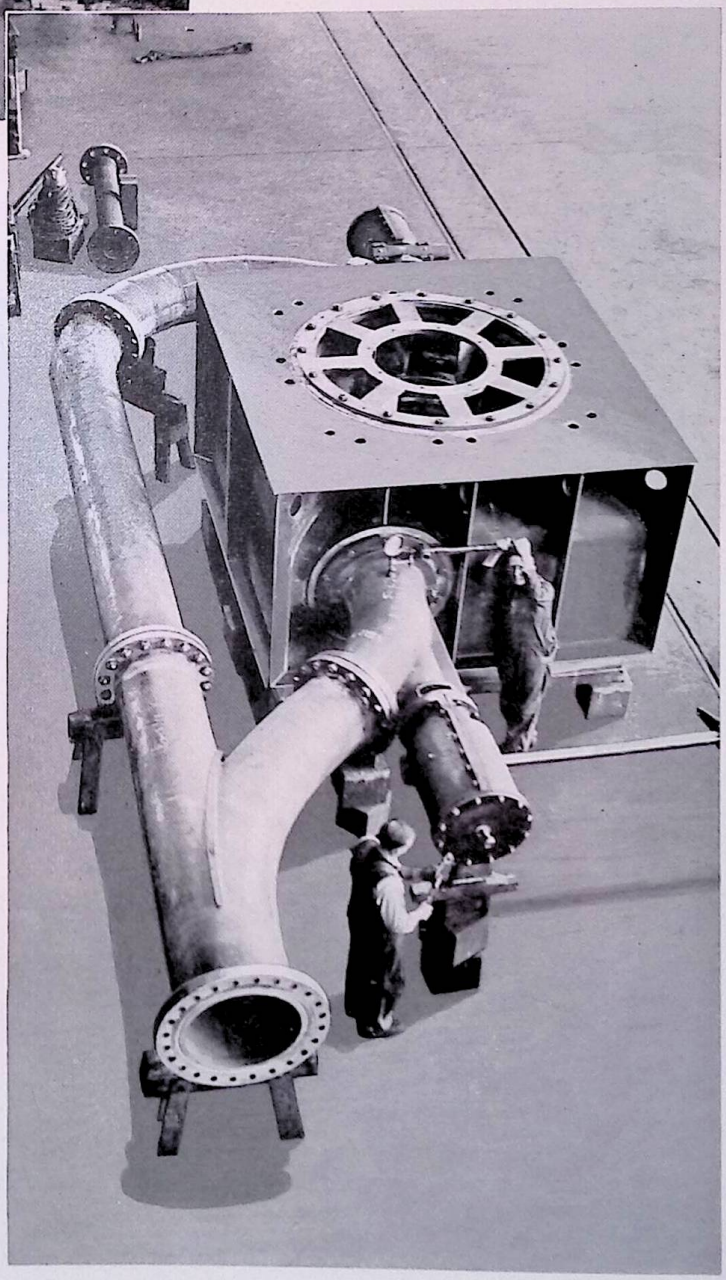
● 7500 H.P. turbine for Comision Federal de Electricidad, Mexico. Las Minas Plant. Head 1450 feet, speed 514 R.P.M. By dual control governor operates both deflector and needle. Note hydraulic Rotovalve on inlet.





● Pinnacles Power House.

● Smith Vertical Impulse turbine, single runner, equipped with two jets, governor controlled, arranged to permit one jet inoperative, thus improving efficiency at all points below 40% of turbine rating.

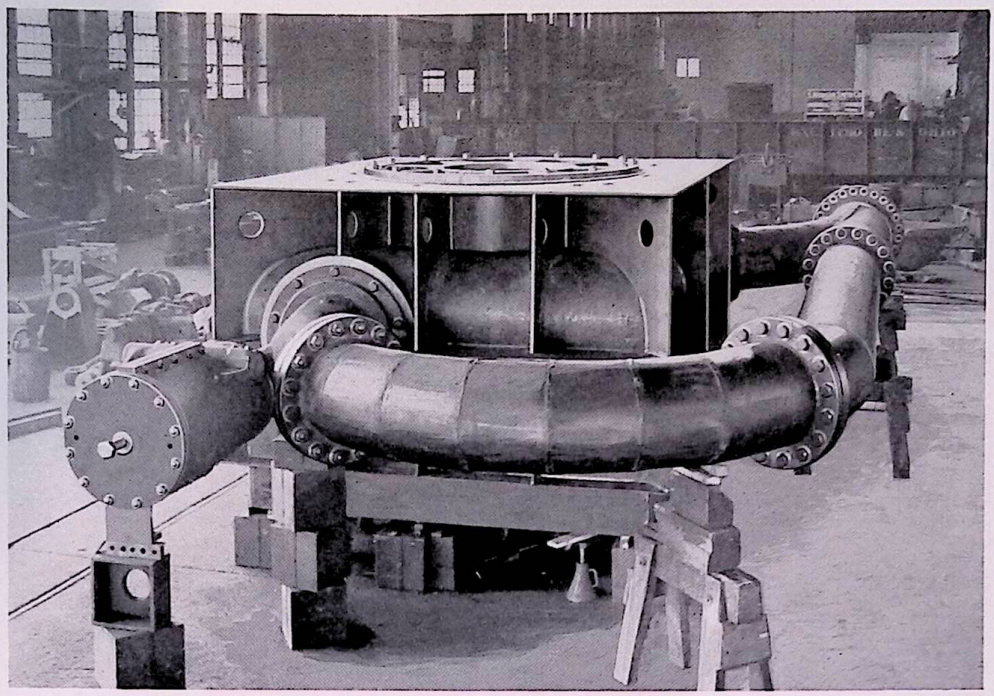


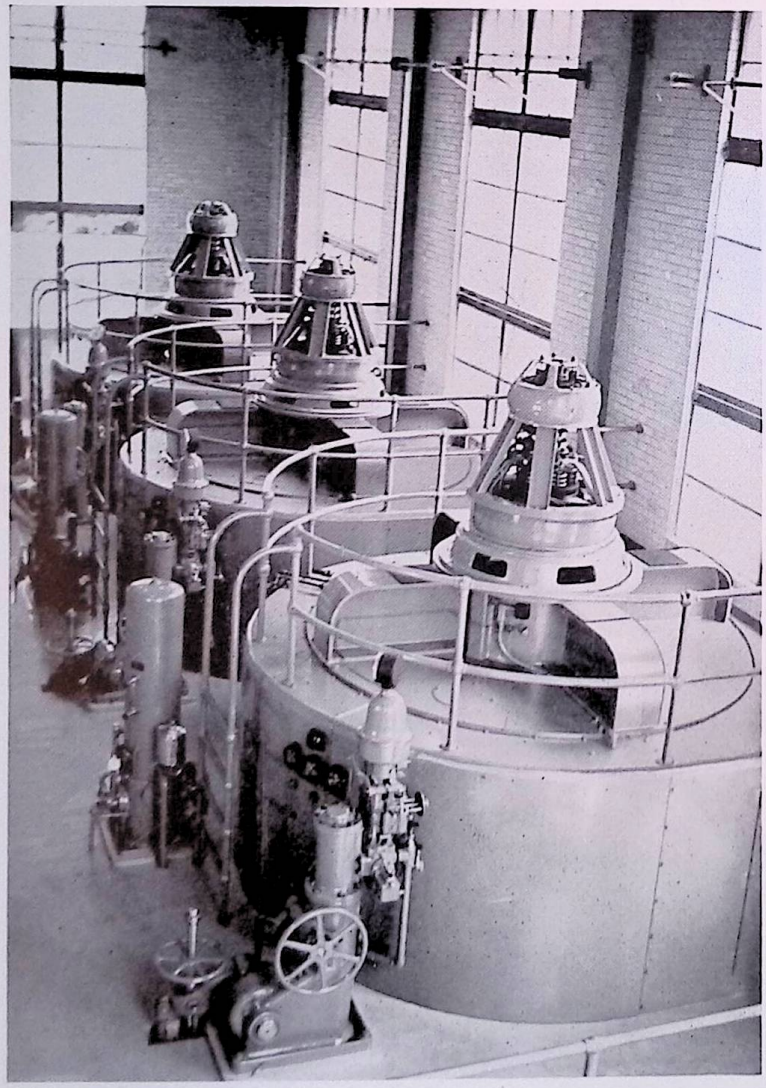
SMITH turbines installed for the City of Danville, at Pinnacles, Virginia, are unusually interesting because they demonstrate the efficiency and economy of the vertical shaft impulse turbine design.

The Big Bend Dam, or storage basin, is of 350,000,000 cubic feet capacity, located in a gorge seven miles upstream from the power house. From this basin the regulated stream flows five miles to the diversion dam, where it enters two miles of pipe line carrying the water to the turbines. Twelve hundred feet upstream from the power house a 125 feet high and 18 feet in diameter surge tank is installed to afford protection against excessive positive or negative pressure waves in the penstock.

At the lower end of this conduit a three-way branch feeds the separate lines which supply

● Downstream view showing all-welded construction of wheel housing and intake piping.

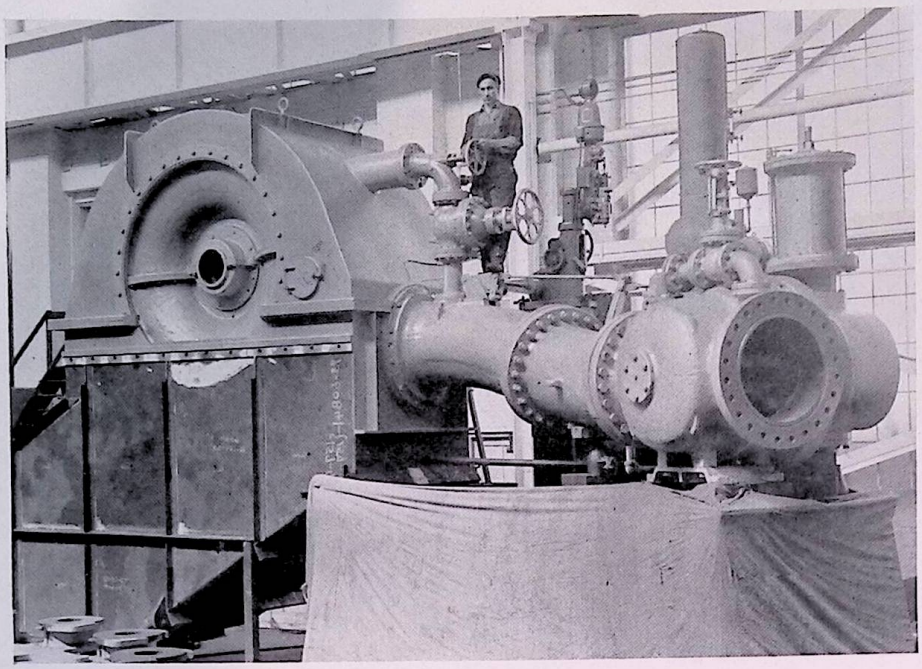




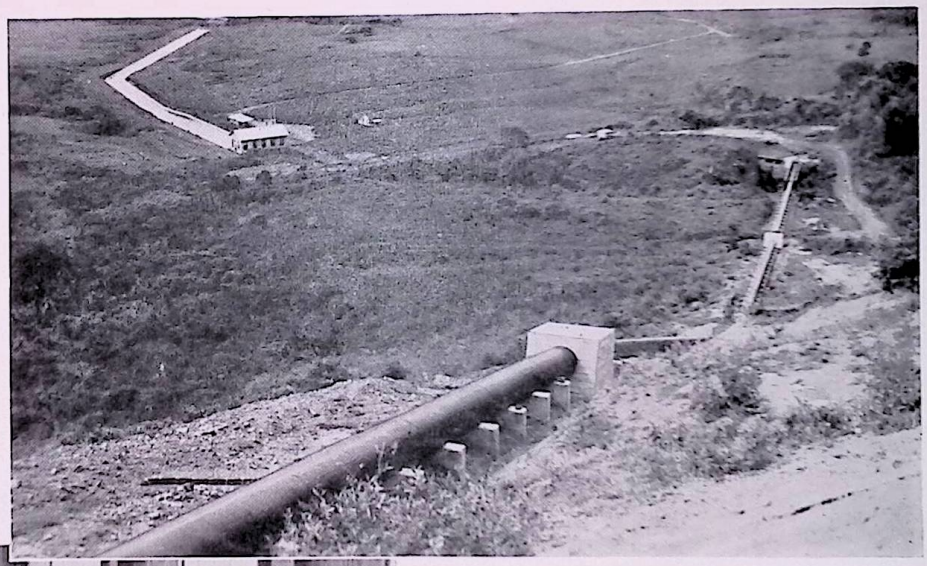
the three vertical-shaft, double-jet Smith Impulse turbines. Each unit develops 5000 H.P. under a net effective head of 660 feet.

An electrically operated Dow "Disc Arm" Pivot valve is installed at the intake of the supply line; a Butterfly valve electrically controlled is placed immediately downstream from the surge tank; and each turbine intake is equipped with an electrically operated conical-plug Rotovalve with full circular opening equal to the pipe-line size. All valves are controlled from the power house.

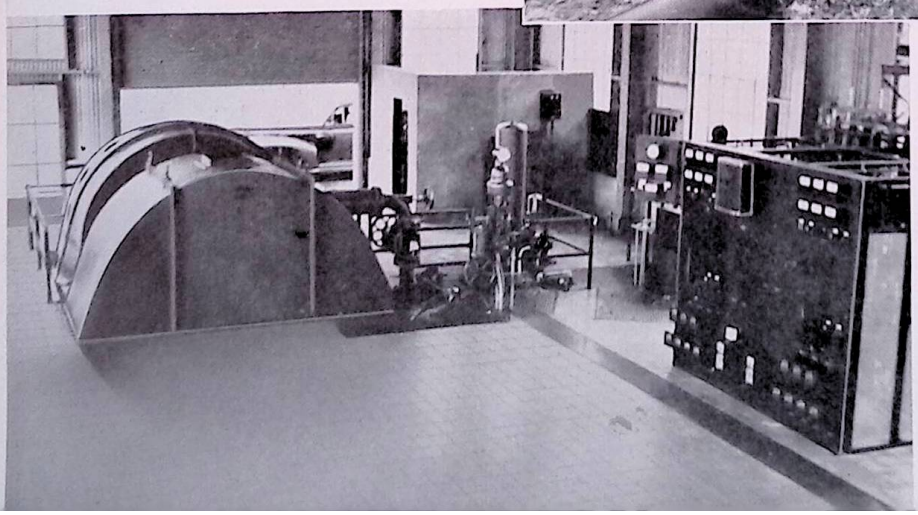
● Generator Room.



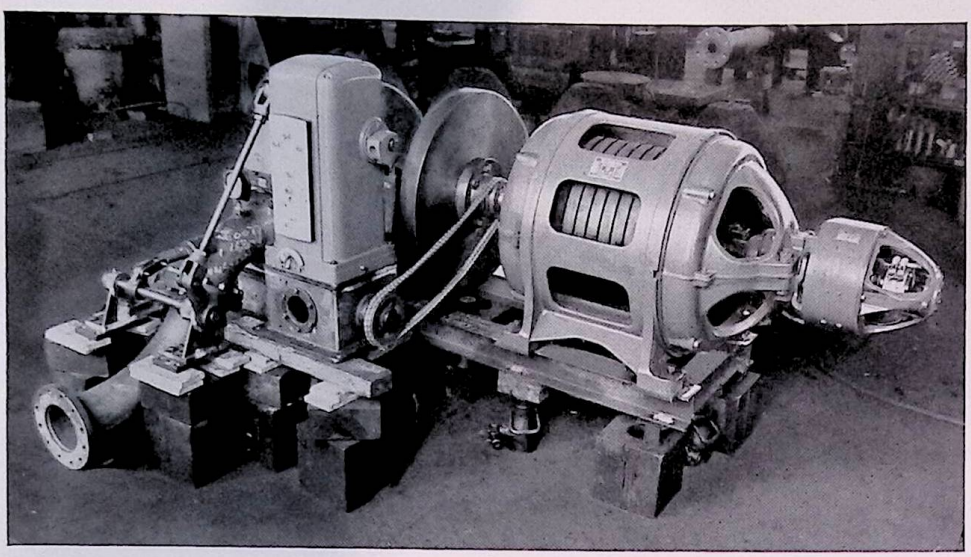
● Shop assembly of first of two 3600 H.P. turbines for Nima No. 2 Plant of the Cia Colombiana de Electricidad, Colombia, S.A. Head 656 feet, speed 360 R.P.M. Dual control by governor of both deflector and needle. Note the Rotovalve on the inlet.



● Nima penstock leading to power plant in background. Note the tail race beyond plant.

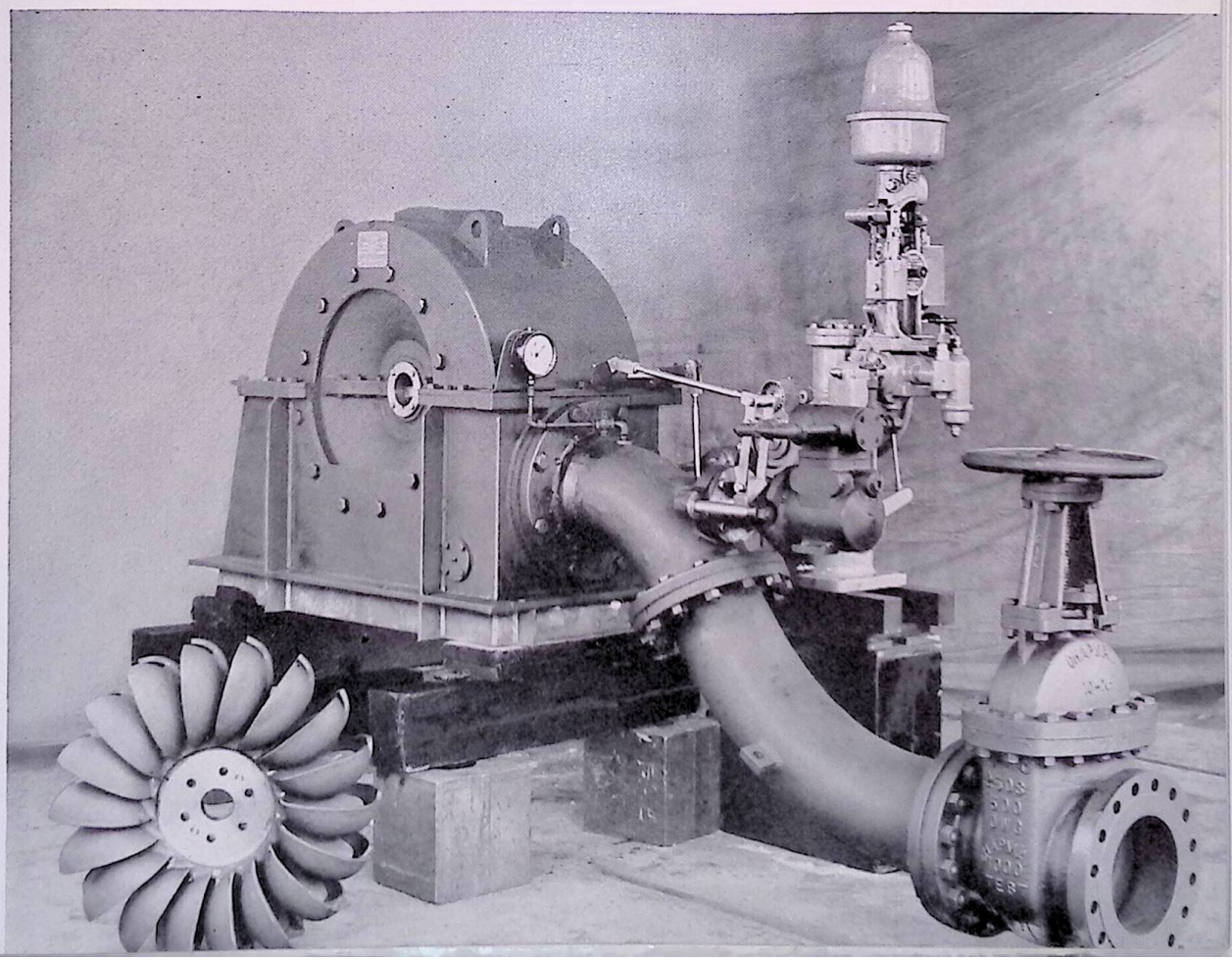


● Interior of Nima Plant prior to installation of the second unit.

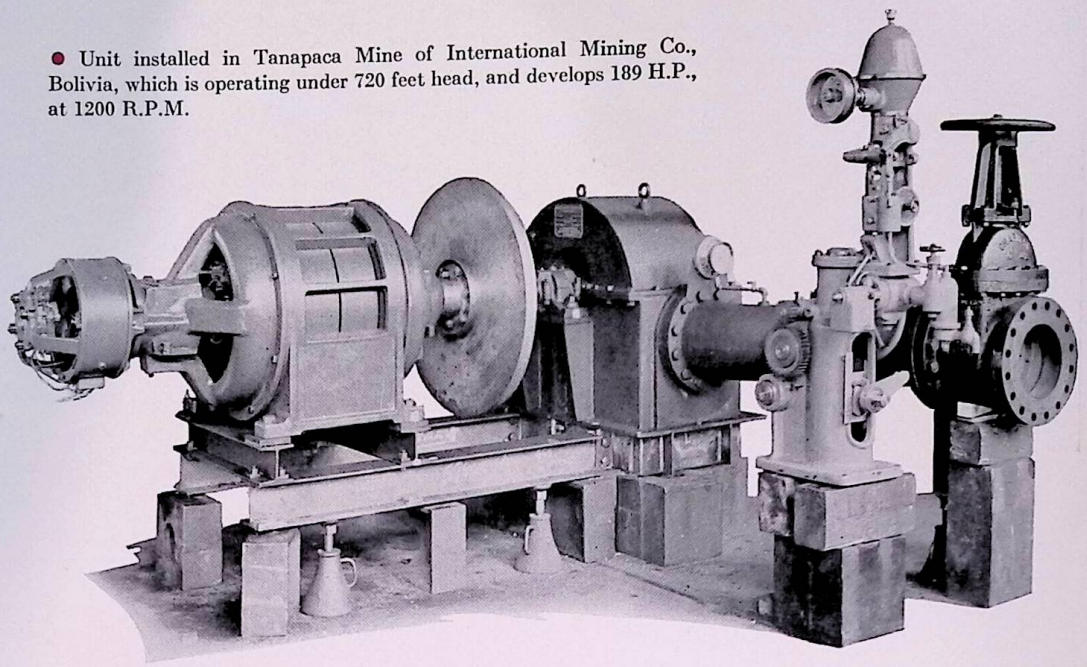


● This 338 H.P. Smith Impulse turbine is installed in the Sopetias Plant of the Cooperative de Municipalidades de Anticquia, Ltd., Colombia.

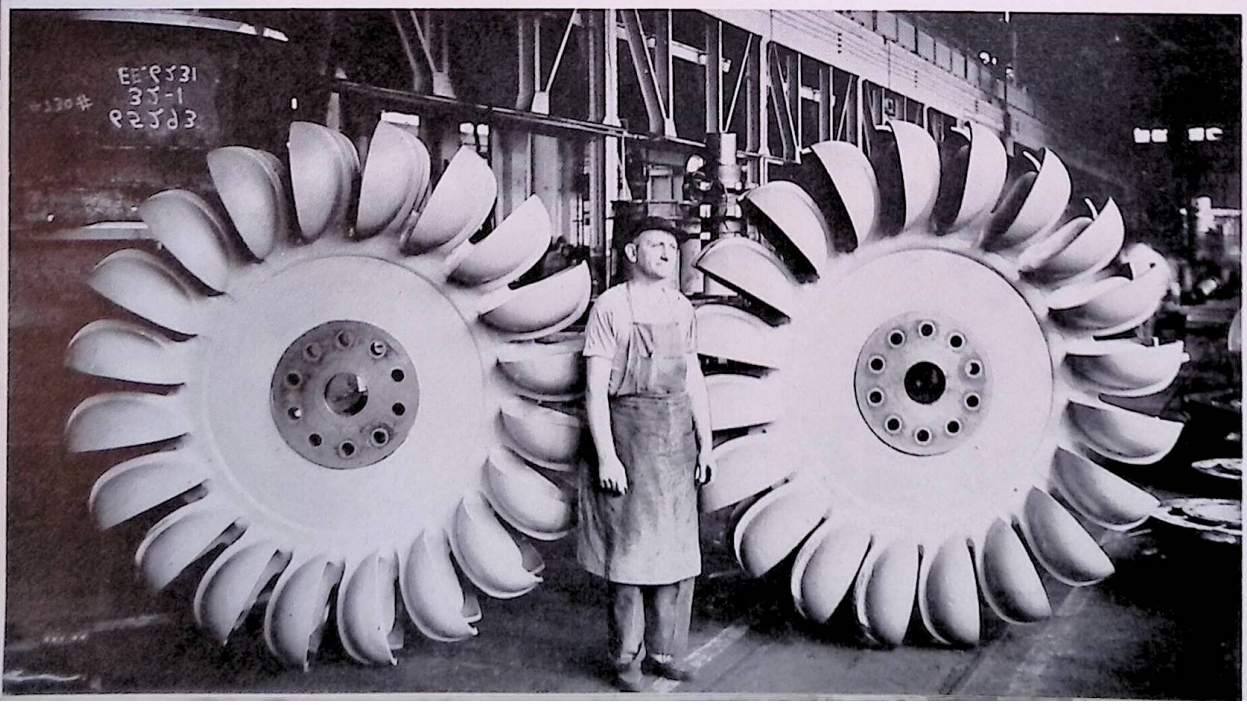
● A 320 H.P. unit for the Rio Engenio Plant of the Comision Federal de Electricidad, Mexico. Head 496 feet, speed 900 R.P.M. Dual control of both needle and jet deflector by the governor.

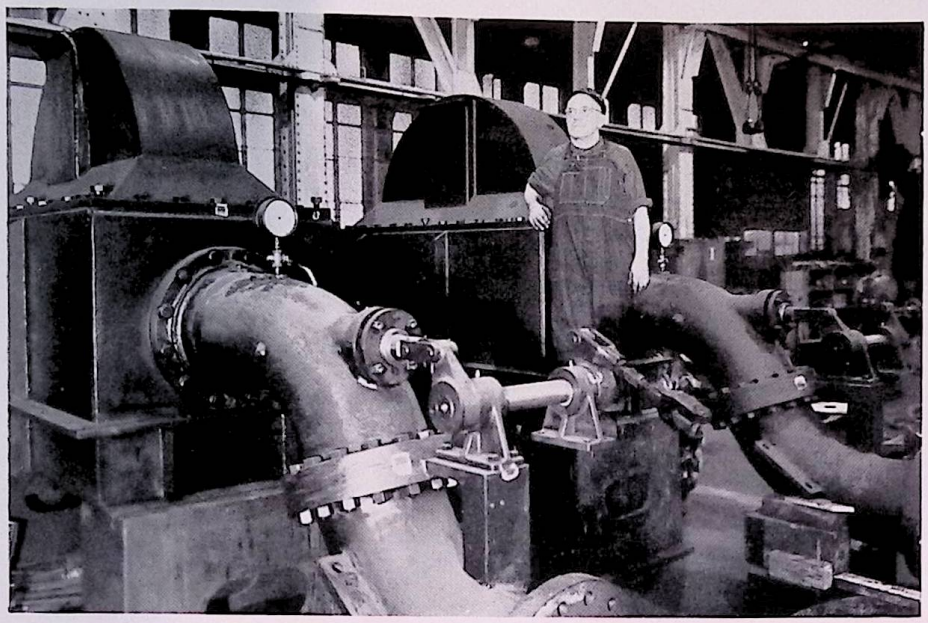


● Unit installed in Tanapaca Mine of International Mining Co., Bolivia, which is operating under 720 feet head, and develops 189 H.P., at 1200 R.P.M.



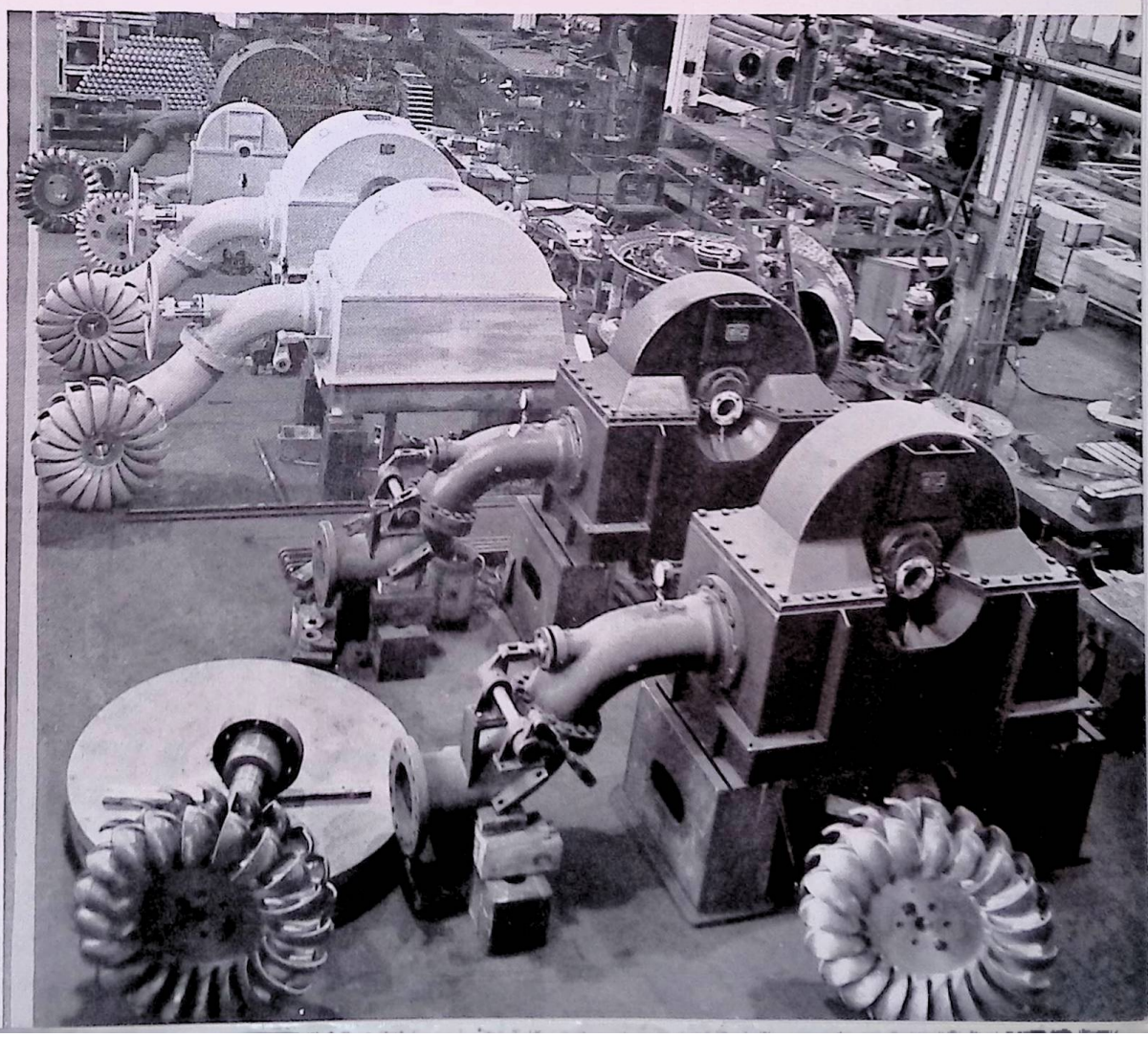
● Shop view of Solid Cast Impulse Runners.

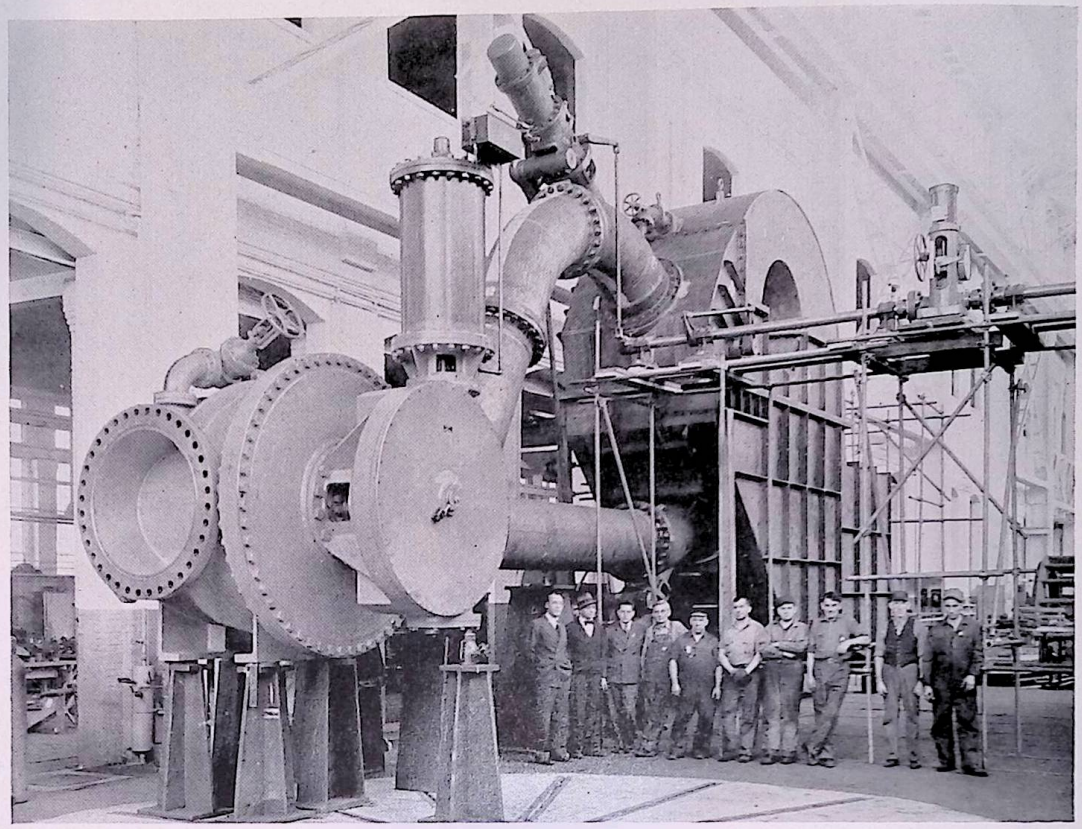




● Two 755 H.P. turbines for installation in Mexico. Head 526 feet, speed 600 R.P.M. Governor operates needle.

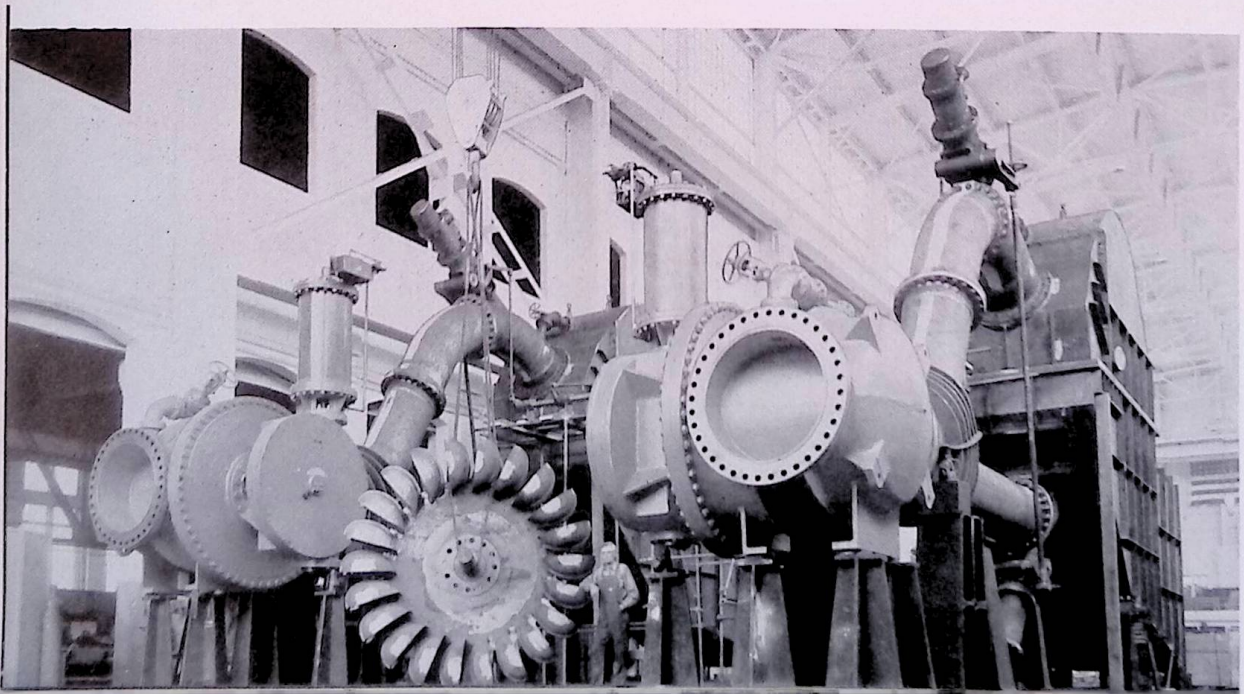
● Group of Impulse turbines assembled in the Smith shops. In foreground are two units of moderate specific speed. In middle ground are two turbines of high specific speed. Note relatively large-size buckets. In background is runner for low specific speed turbine. Note the difference in size of buckets.

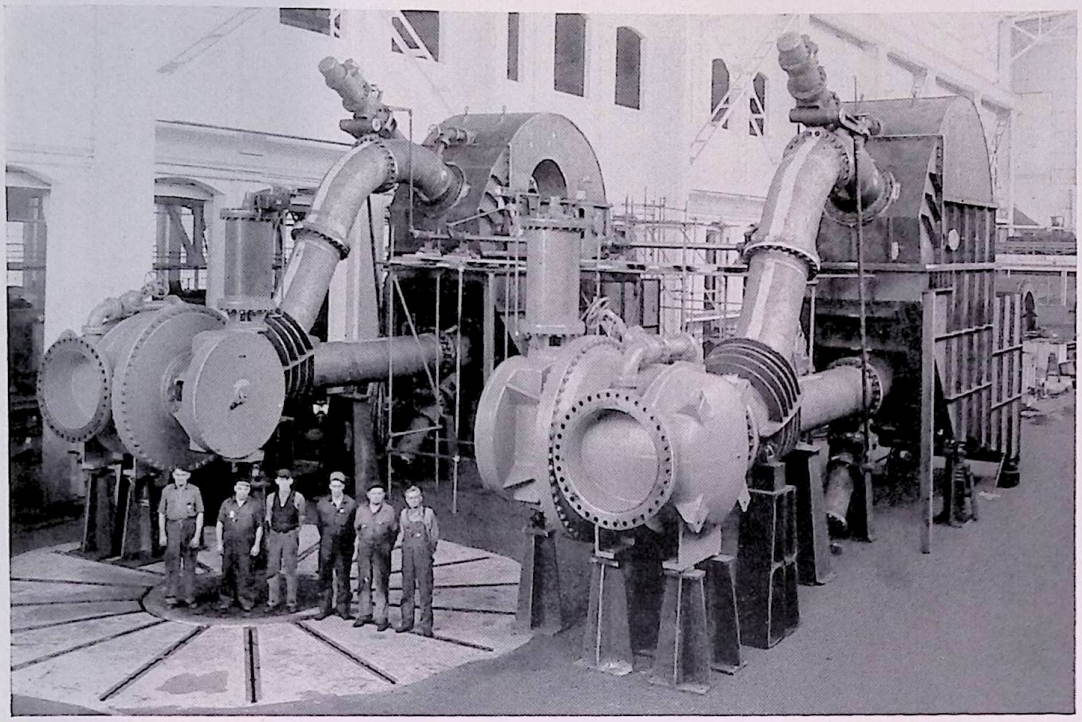




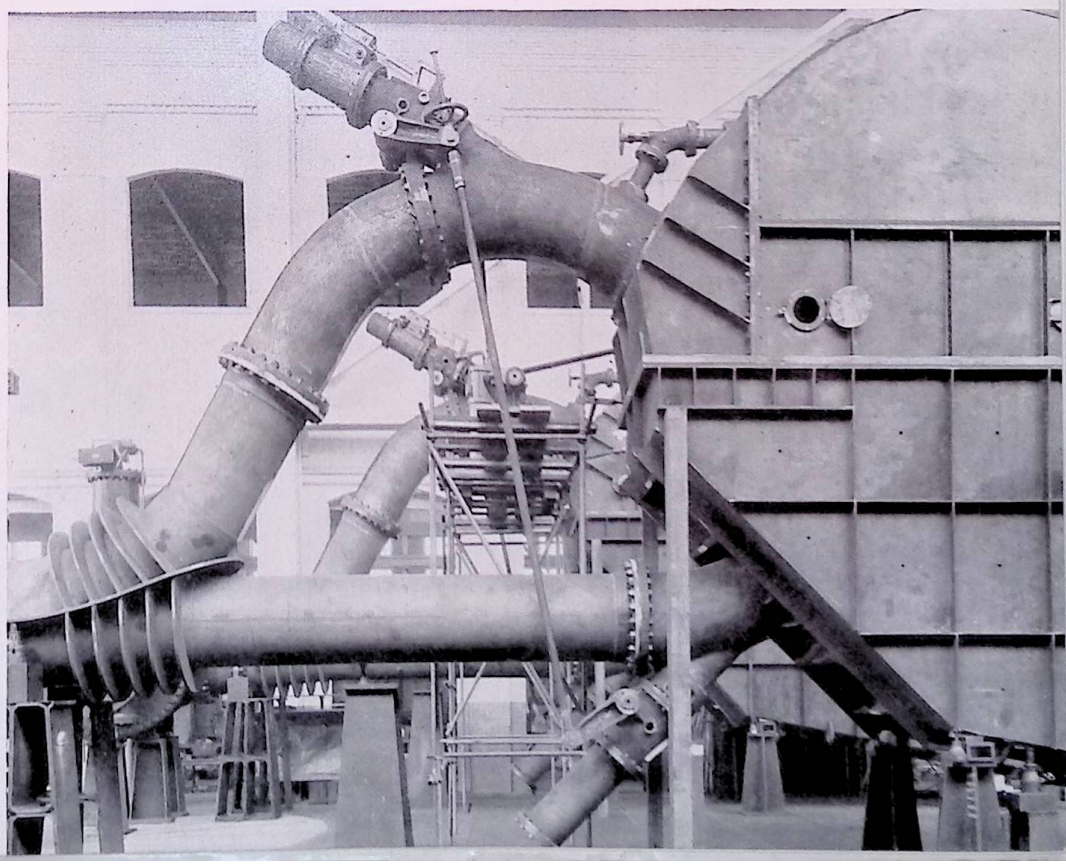
● Shop assembly of one half of a 17,750 H.P. double overhung Impulse turbine manufactured for the Cia Chilena de Electricidad, Ltd., Chile, S.A., Volcan Plant. The 42-inch Hydraulic Rotovalve is used for shutting off flow to one runner.

● View of both Rotovalves with one runner in foreground.





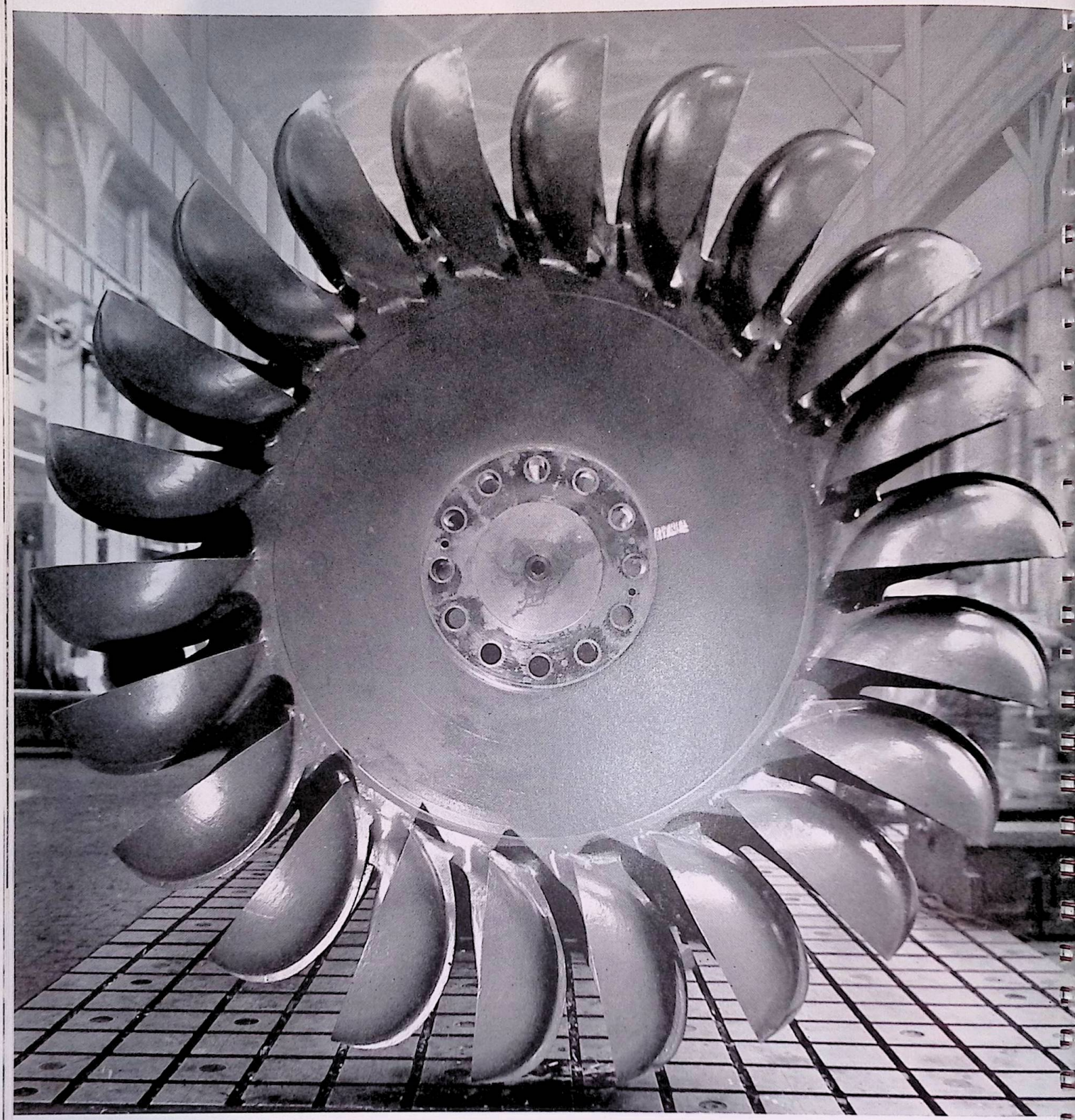
● Wye branches beyond the valves for dividing the flow to upper and lower jets. Two jets supply each of the two runners. The generator rotor is mounted on the one-piece turbine shaft between the two halves of the unit.



◎ Side view showing servomotor mounted on upper nozzle pipe, with connecting rod for operation of lower needle. By dual control, governor actuates deflectors at each of four jets, this being followed by automatic movement of needles at slow rate to prevent water hammer.

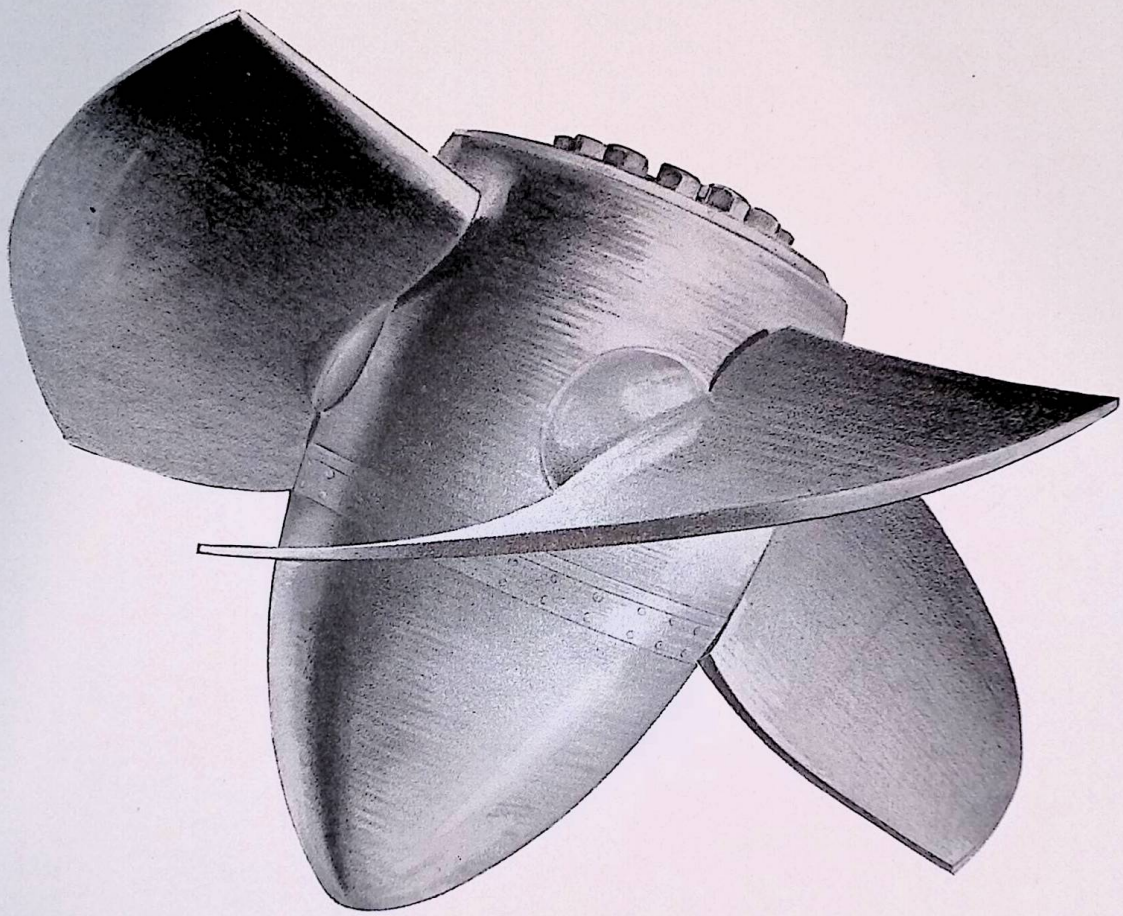
Interior of Volcan Power House

POWER *by* SMITH

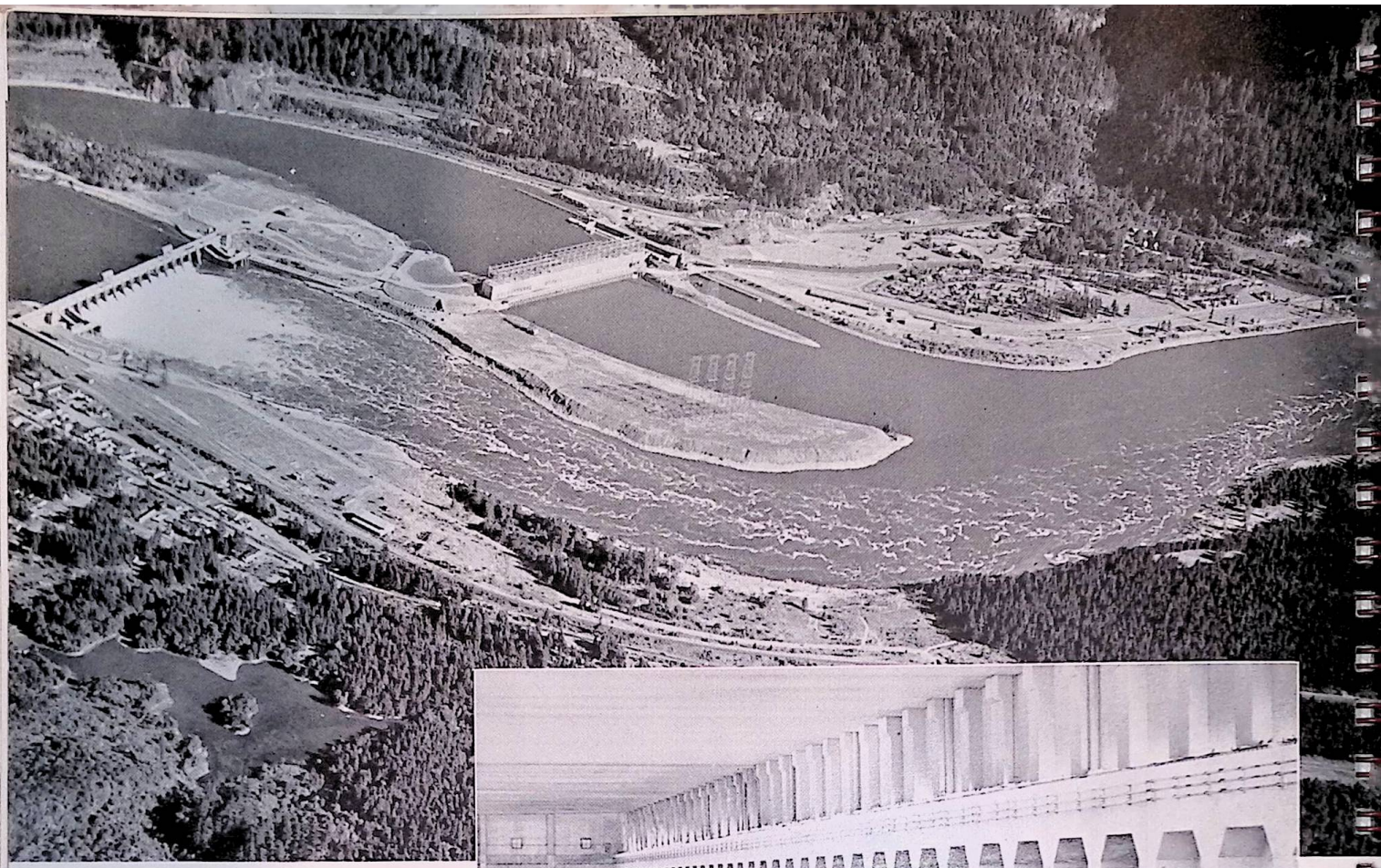


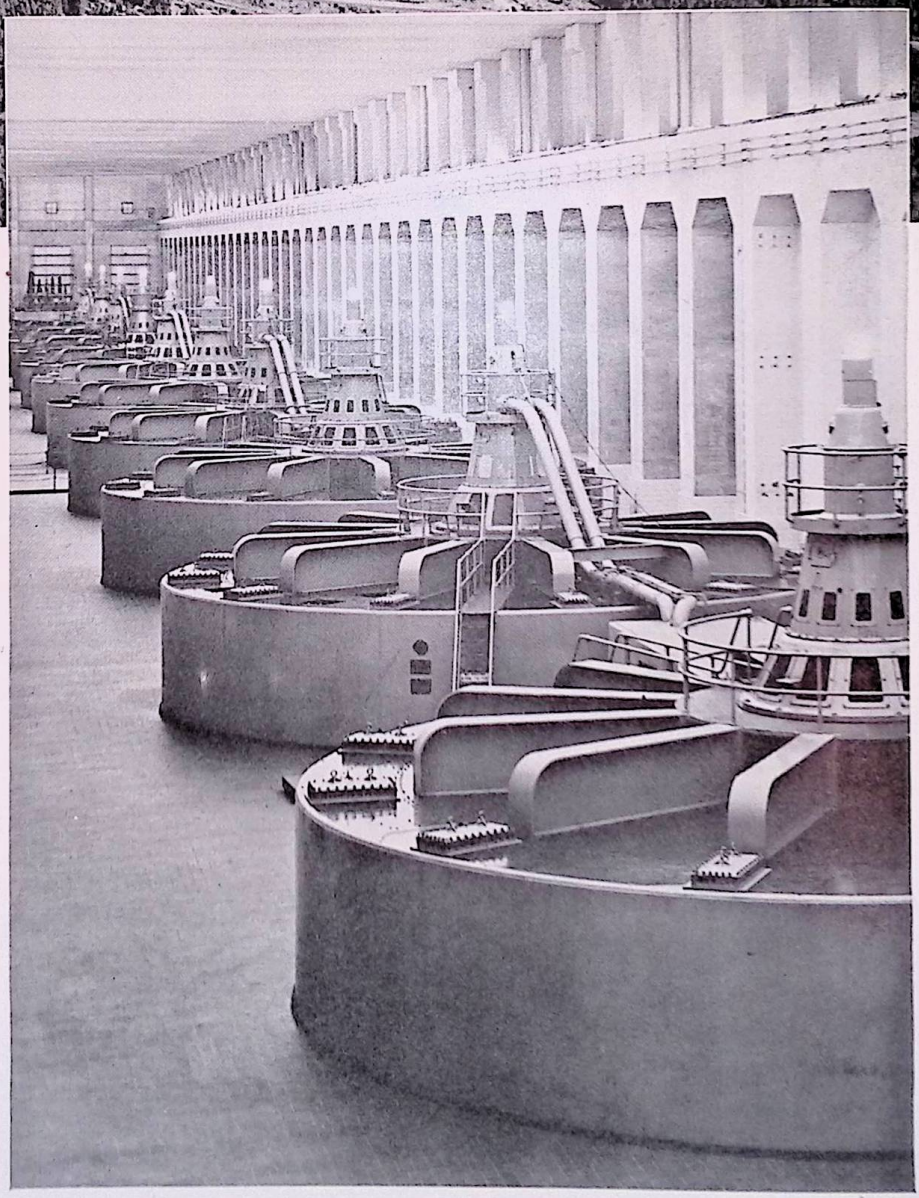
One of the Solid Cast Volcan Runners.

Smith-Kaplan Adjustable Blade Turbines

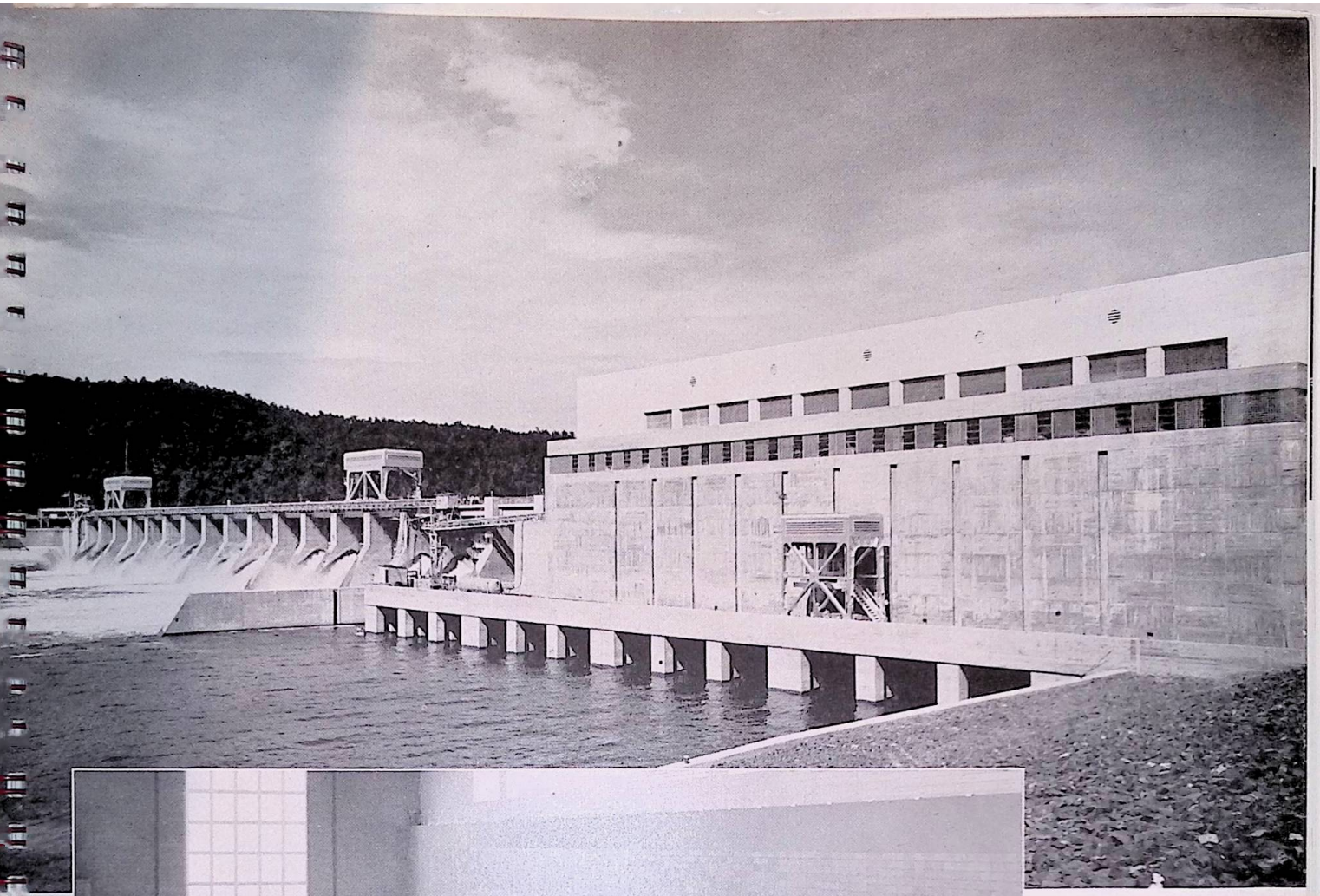


THE most marked advantages of this type turbine are its ability to maintain high efficiency over a wide range of load, and to provide a high output under reduced head conditions. Both are contributory factors in deriving *more power* from the average stream, where wide variations of flow and head exist. These points of superiority are even more pronounced when considered with the high specific speed of the Smith-Kaplan turbine, which permits economy of over-all installation due to higher speed generators and savings in power-house size with resulting lower costs. In modern practice this type unit may be installed under heads up to 125 feet.



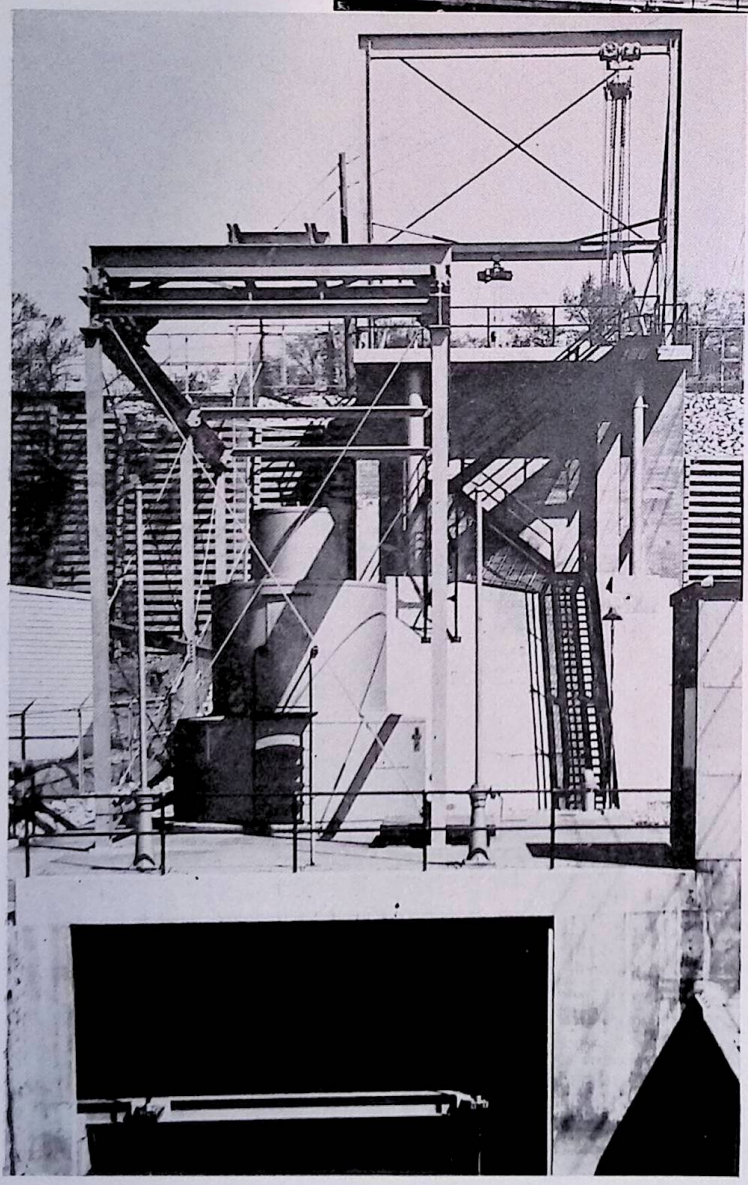


● The U.S. Engineers Bonneville Plant, on the Columbia River in Oregon, has ten main generating units of the Smith-Kaplan type. Each turbine develops 74,000 H.P. under 60 feet rated head while running at 75 R.P.M. The corresponding flow is 12,700 cubic feet per second. In addition, a 5000 H.P. Smith-Kaplan machine was furnished for Station service.

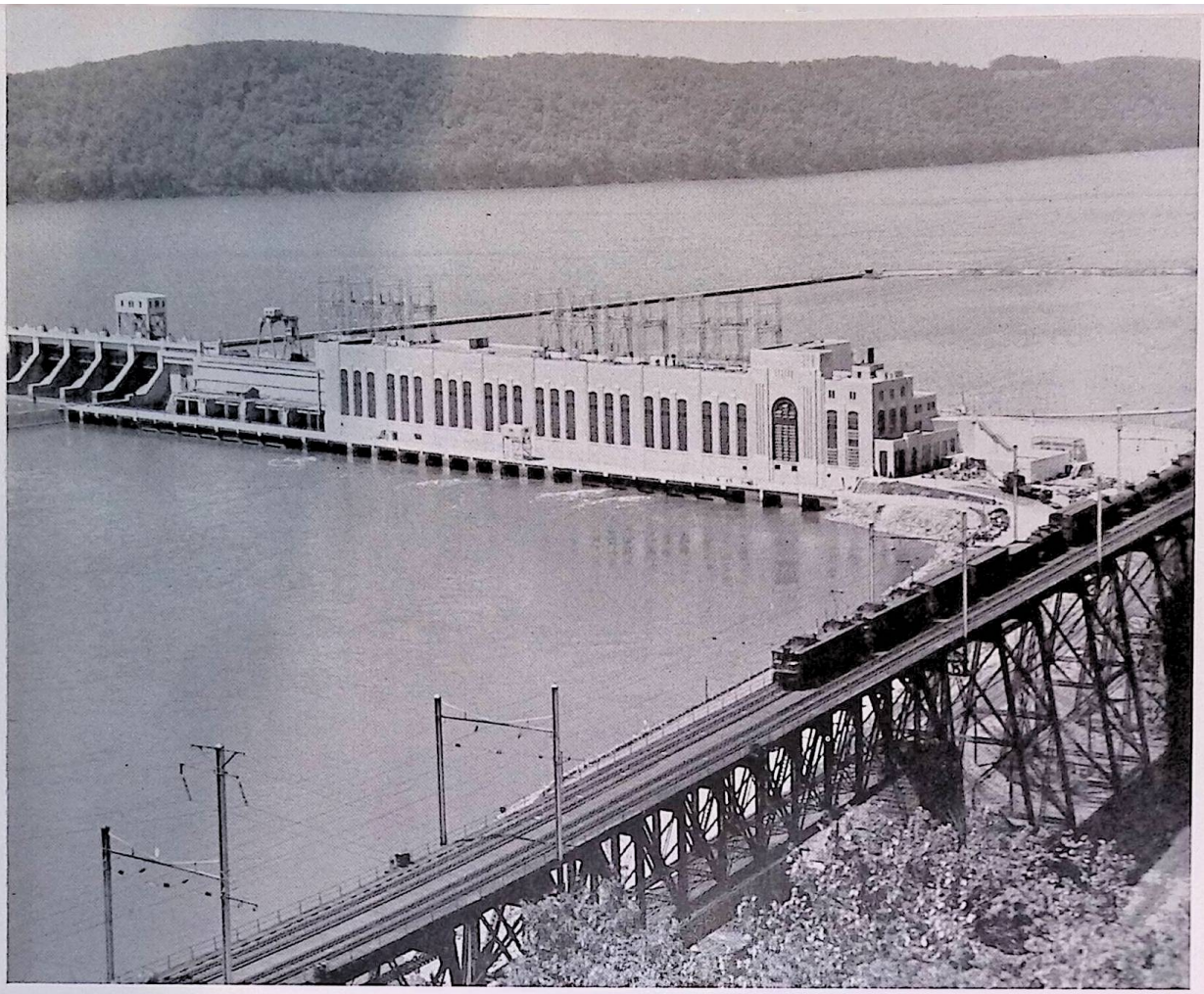


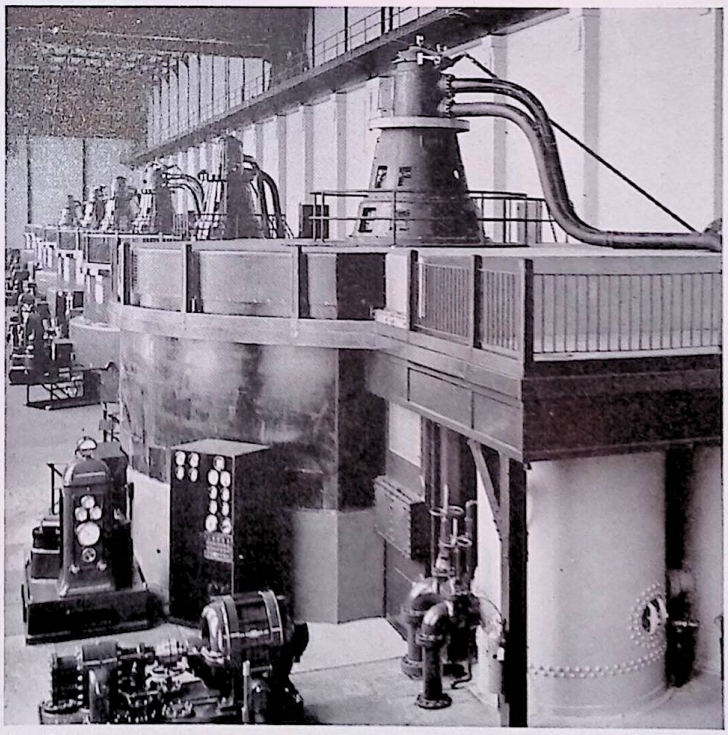
The Guntersville Development, located on the Tennessee River in northern Alabama, is one of the main plants in the generating system of the Tennessee Valley Authority. The three Smith-Kaplan Adjustable Blade Propeller turbines in this Plant are among the largest in the world. They are rated at 39,000 H.P. under 42 feet head. Speed 69.2 R.P.M. A fourth unit is being built by us.

Rockton Development of Wisconsin Light and Power Company is an example of an unattended automatic station. It contains one Smith Fixed Blade and one Adjustable Blade turbine of the same runner diameter. At 11 feet net head the first unit gives 800 H.P., and the second develops 994 H.P.

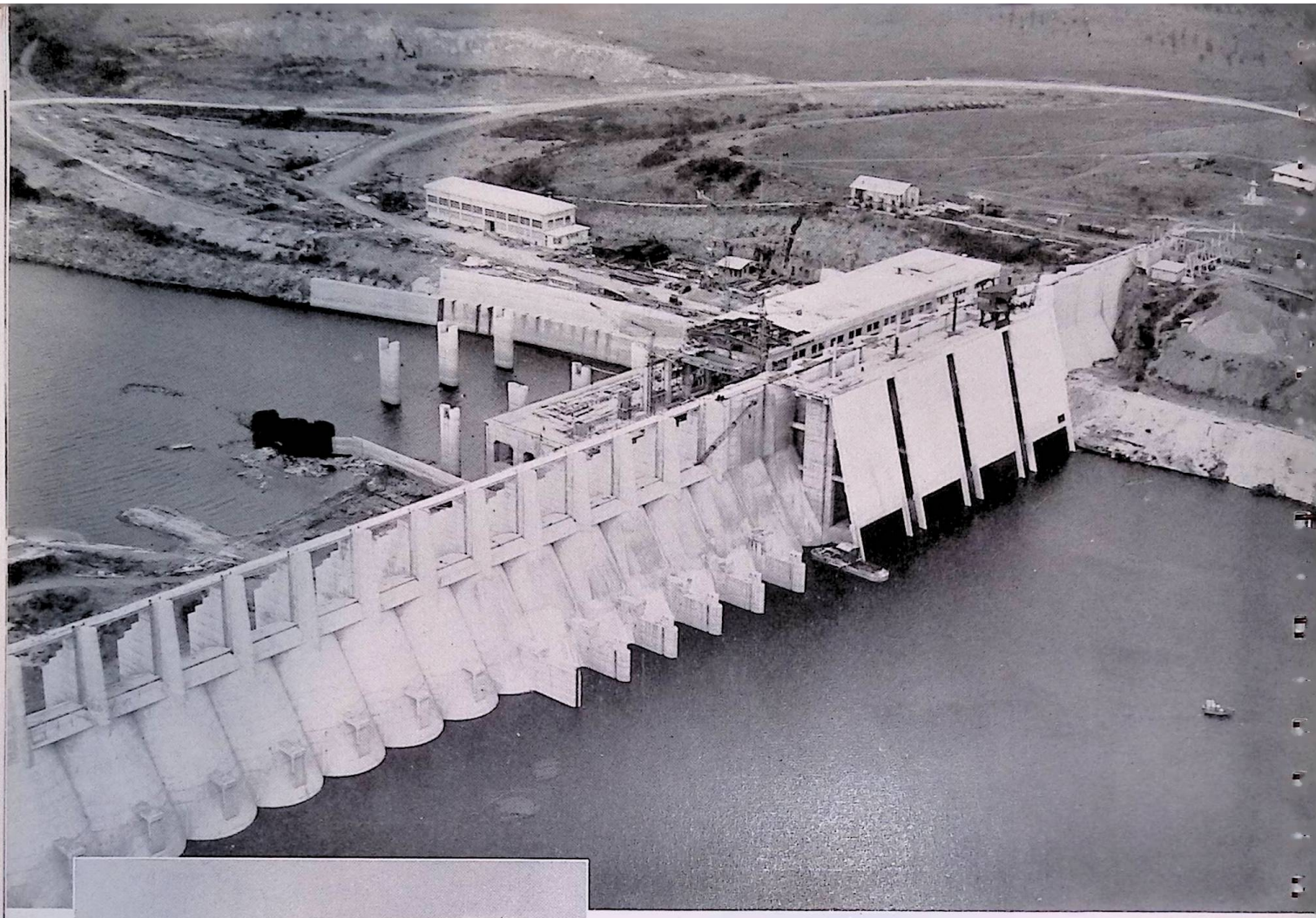


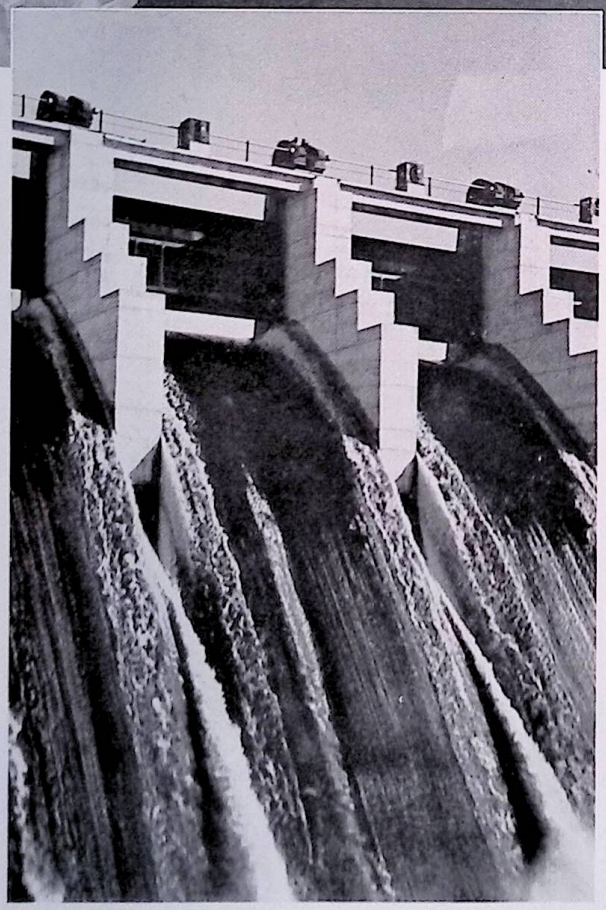
Another automatic unattended station, with outdoor generator and Smith-Kaplan turbine. This unit utilizes an effective head of 46 feet from the old Chesapeake & Ohio Canal to the James River, developing 3880 H.P. at 257 R.P.M. The property of Virginia Electric and Power Company of Richmond, the plant is known as Park Station.



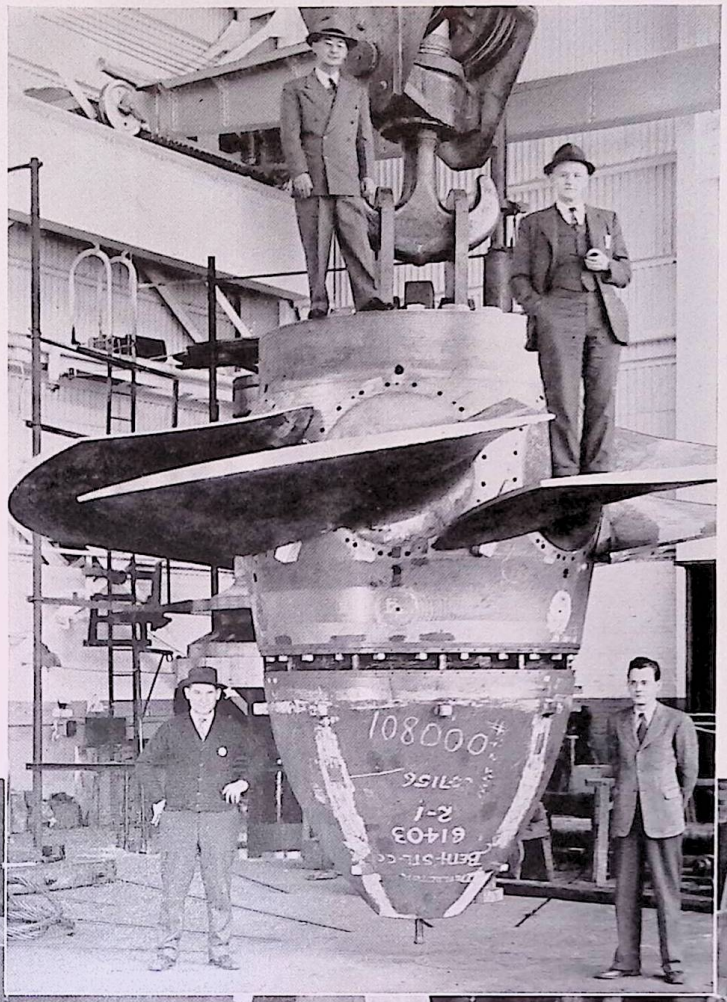


● The Safe Harbor Water Power Company's plant on the Susquehanna River in Pennsylvania, contains six units of the Kaplan type. Each turbine develops 42,000 H.P. under 55 feet head. Note Kaplan-type oil supply head on top of generators.



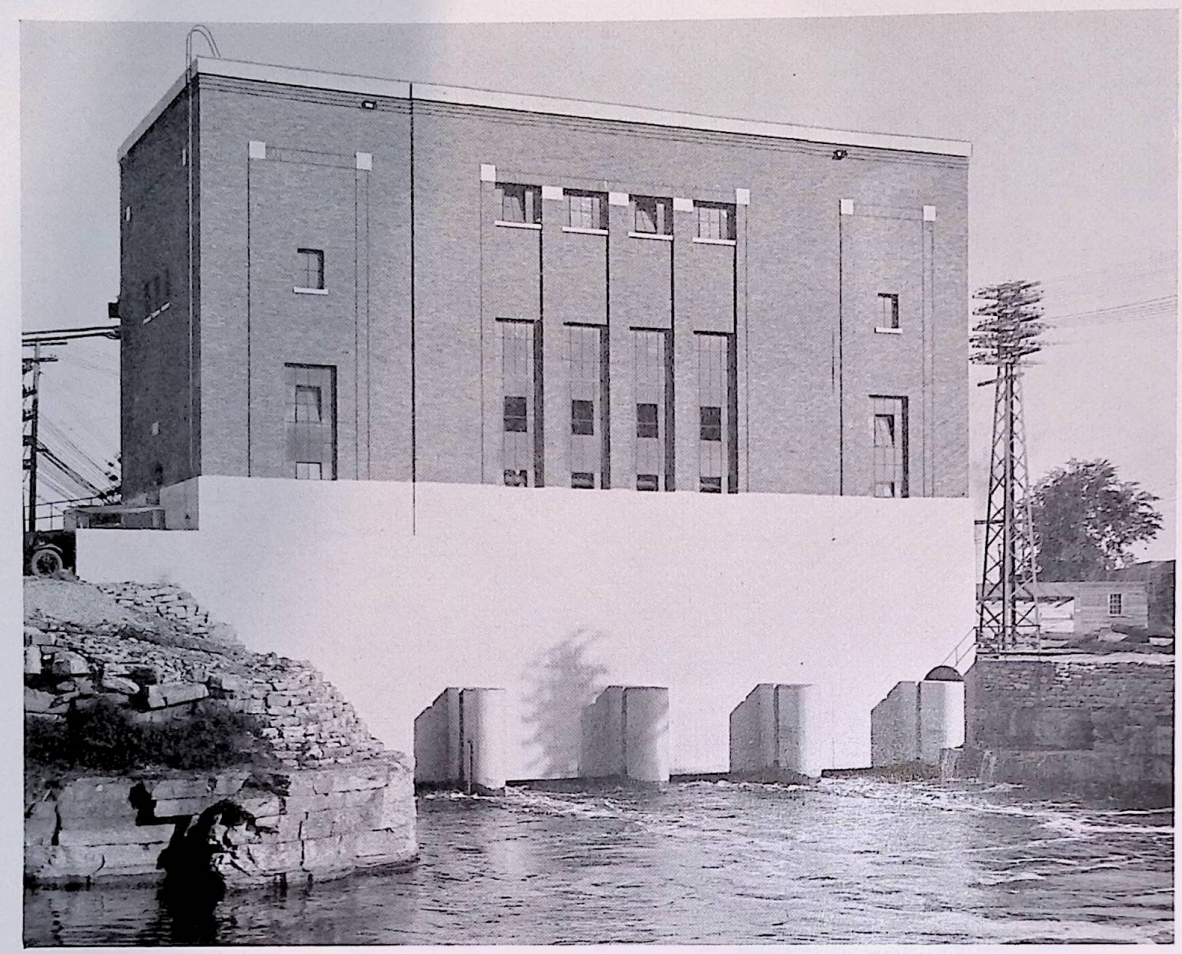


The Rıone Plant of the Government of Uruguay on the Rio Negro River has four Smith-Kaplan units in operation. Each unit is rated at 40,000 H.P., 125 R.P.M., under 69.2 feet head. These machines operate over a head range of from 54.8 to 105 feet.

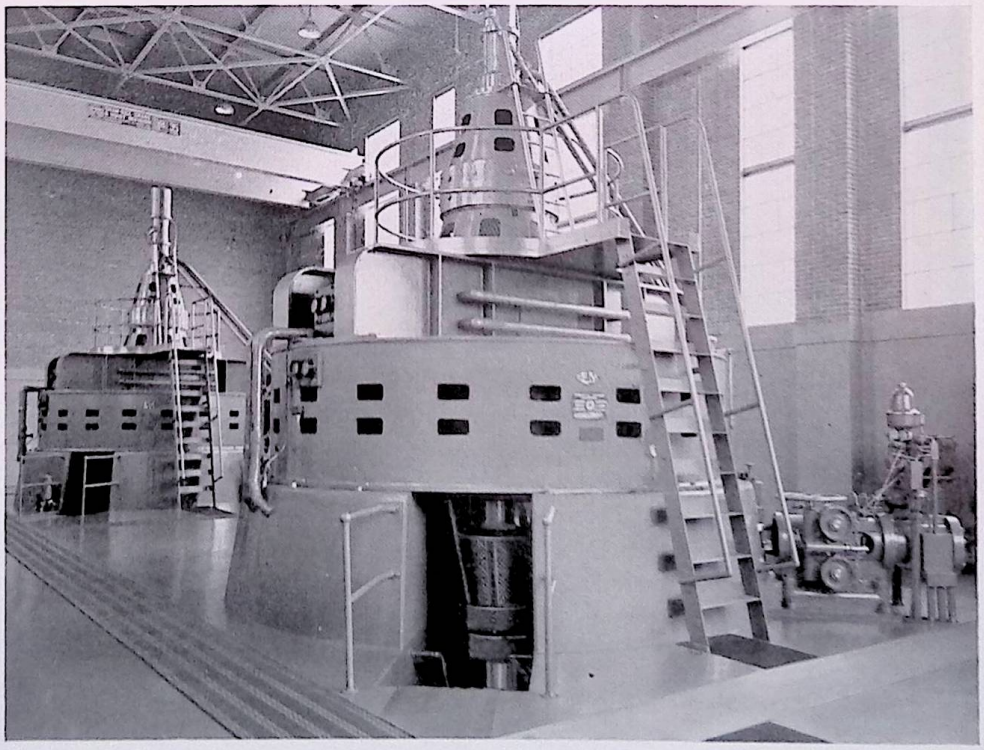


● One of the six-blade runners for the Rione Plant. Its total assembled weight is in excess of 176,000 pounds.

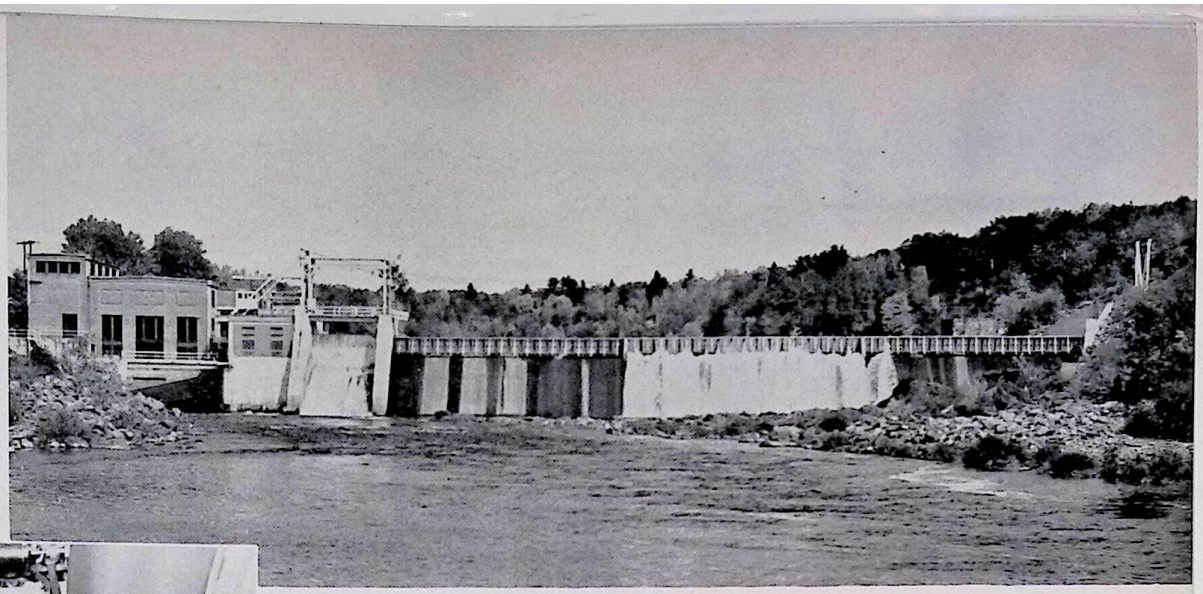
● Shop view of inner and outer head covers showing gate operating mechanism.



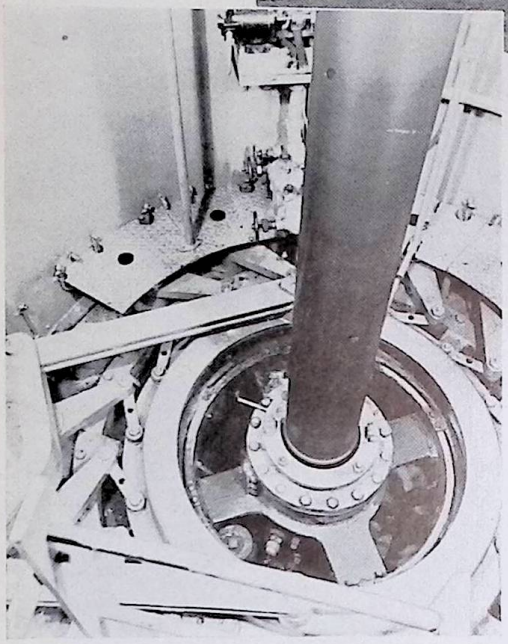
● New Badger Plant of Green Bay and Mississippi Canal Co., containing one Fixed and one Adjustable Blade Smith-Kaplan turbine.



● Interior of Thilmany Plant of the same Company, in which two 3300 H.P. units of similar type operate under 22 feet head. These two machines are remotely controlled from the New Badger Plant.

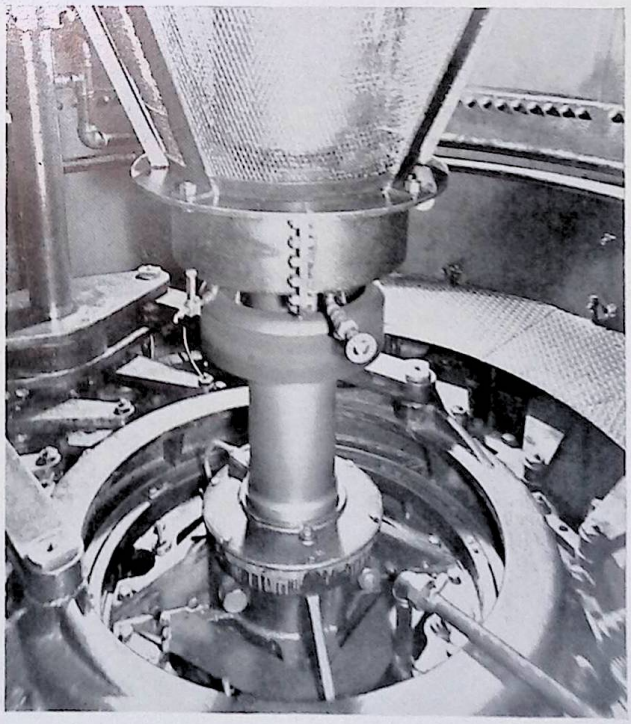


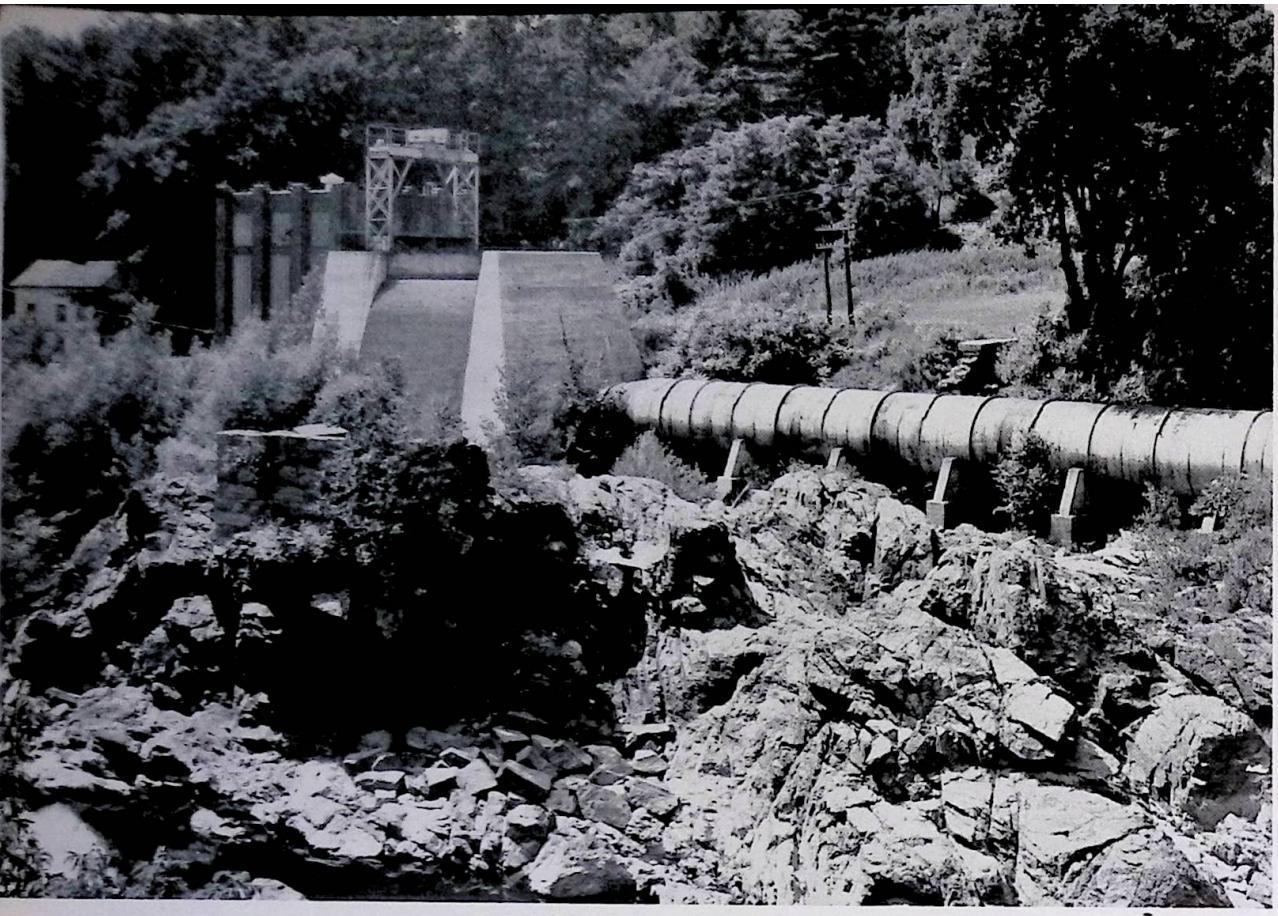
● View of Eastman Falls Plant, of Public Service Company of New Hampshire, in which there is one 76-inch diameter Smith-Kaplan turbine installed, rated at 2650 H.P., and 240 R.P.M., at 33 feet head. Adjacent to the power house is an 11 x 32-foot flood gate and hoist designed and built by the S. Morgan Smith Company. The flashboards of this Plant are collapsible from the bank.



● View of Turbine Pit.

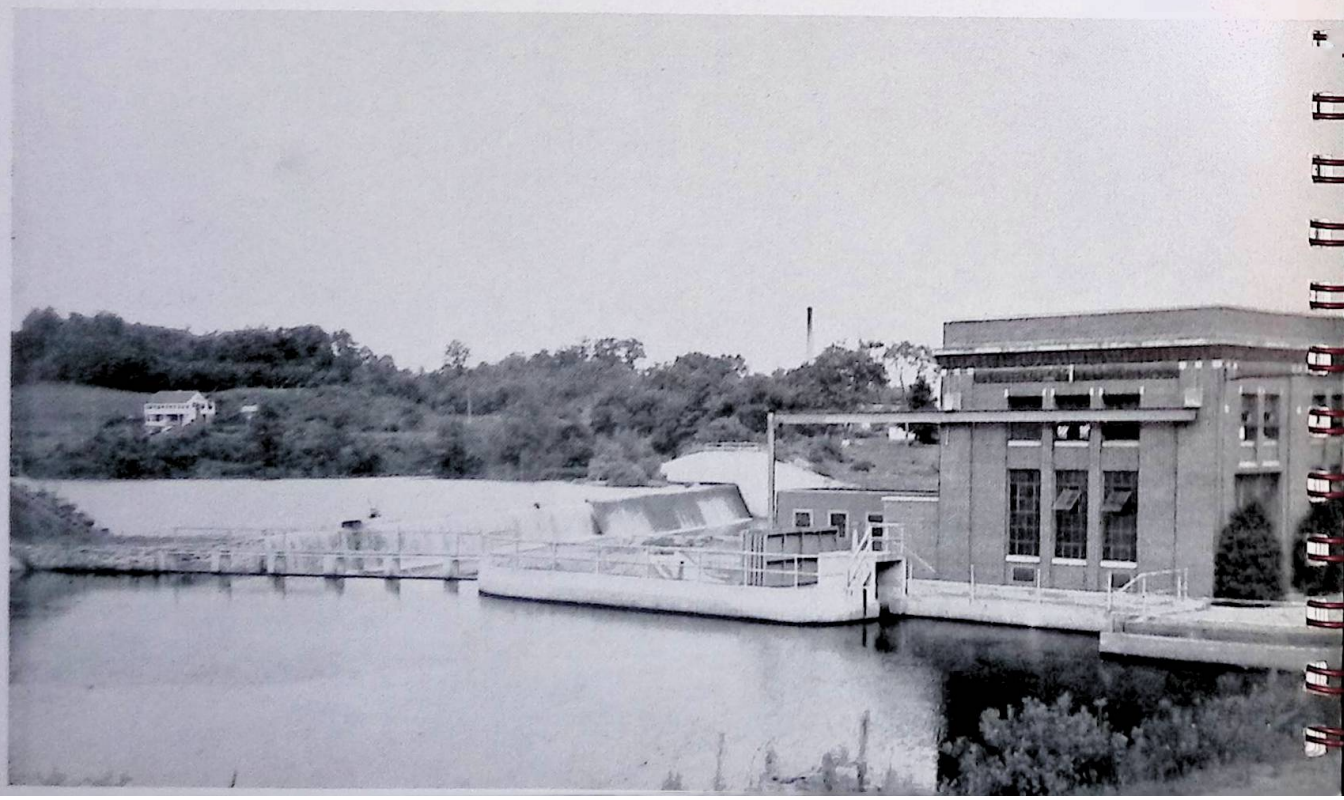
● Turbine pit of another Smith-Kaplan unit in the Dickinson Plant of the City of Holyoke, Massachusetts, showing bearing housing, oil filling basin, and servomotor guard. This machine has a 76-inch diameter runner and is rated at 1015 H.P. under 18 feet head. Speed 180 R.P.M.

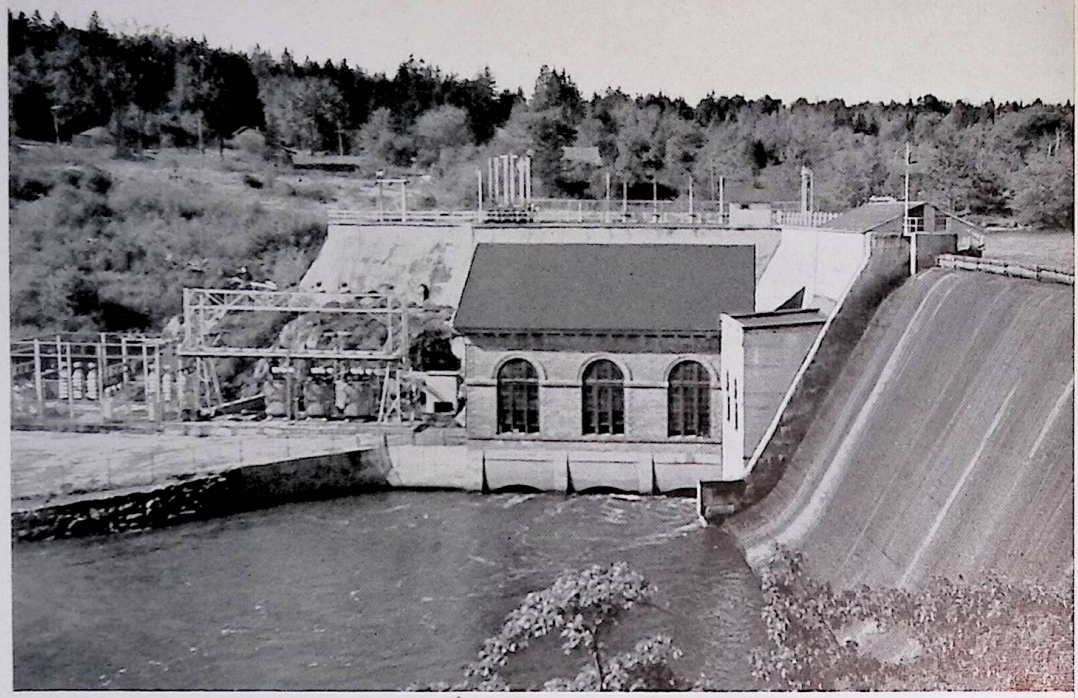




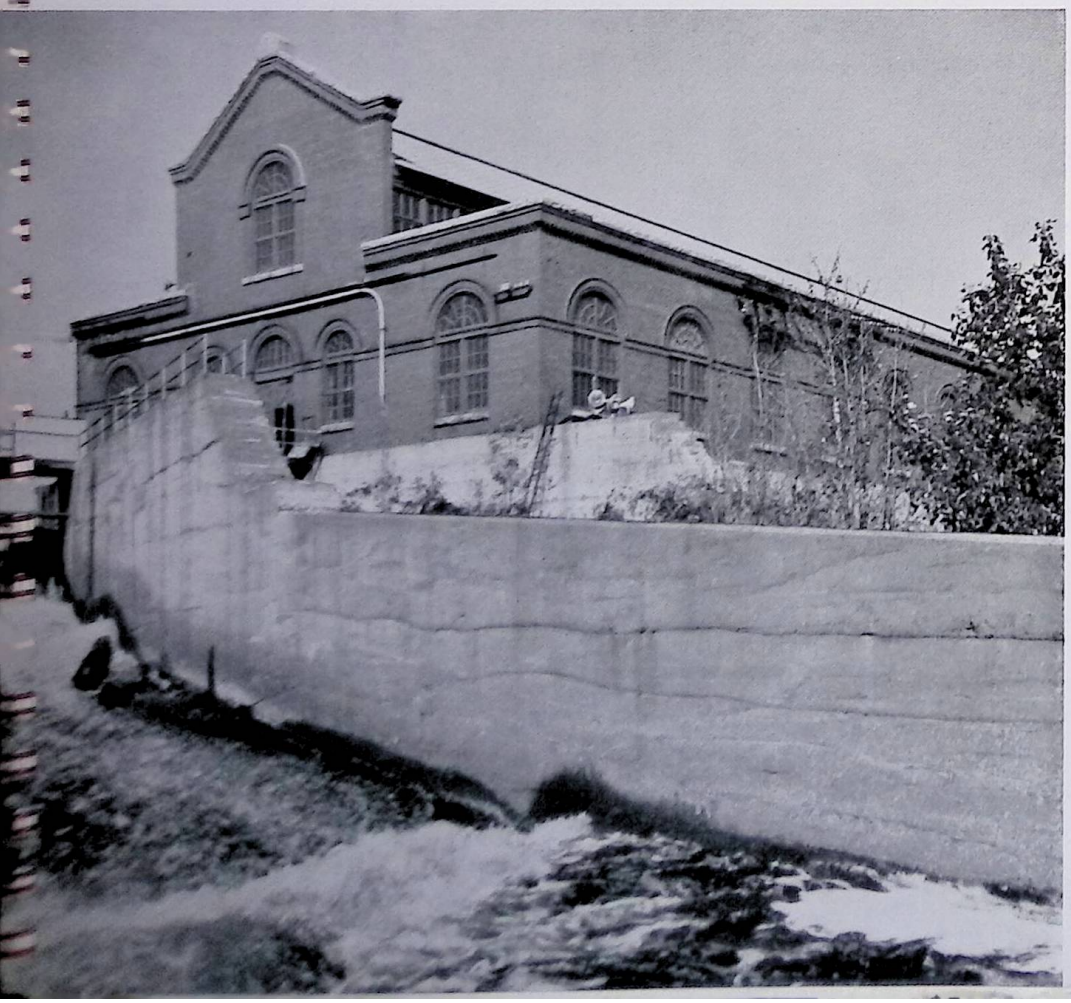
● Another Plant of the Public Electric Light Co., at Milton, Vermont, where there is installed a 4000 H.P. Smith turbine, but of the Kaplan type. The unusual open concrete surge tank and spillway make this Clarks Falls Plant particularly interesting. The hoist shown is for a Broome gate located at the outlet of the surge tank. The station is unattended.

● City of Norwich, Connecticut, Occum Plant, unattended station containing one Adjustable Blade unit of 109 inches runner diameter. It develops 1265 H.P. under 13 feet head. Speed 112.5 R.P.M.

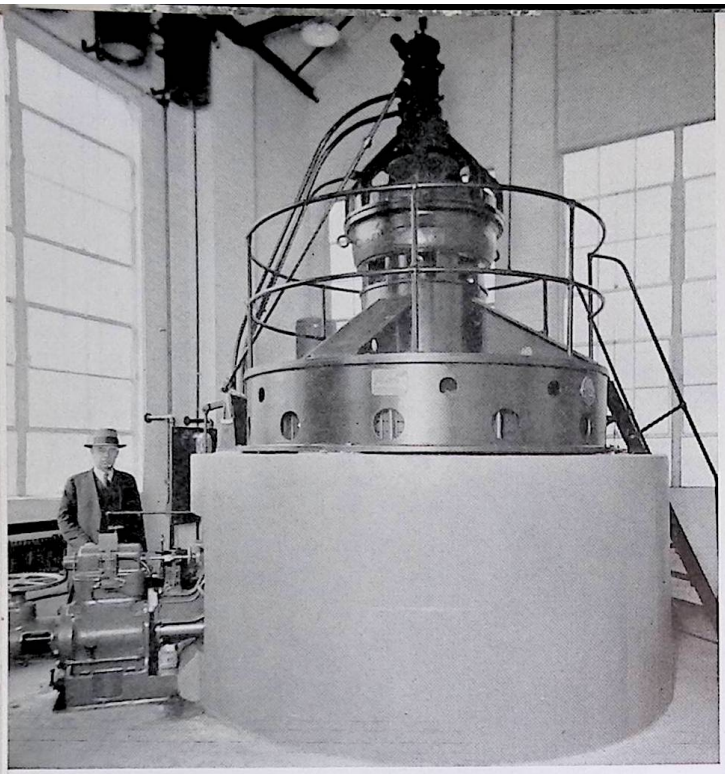




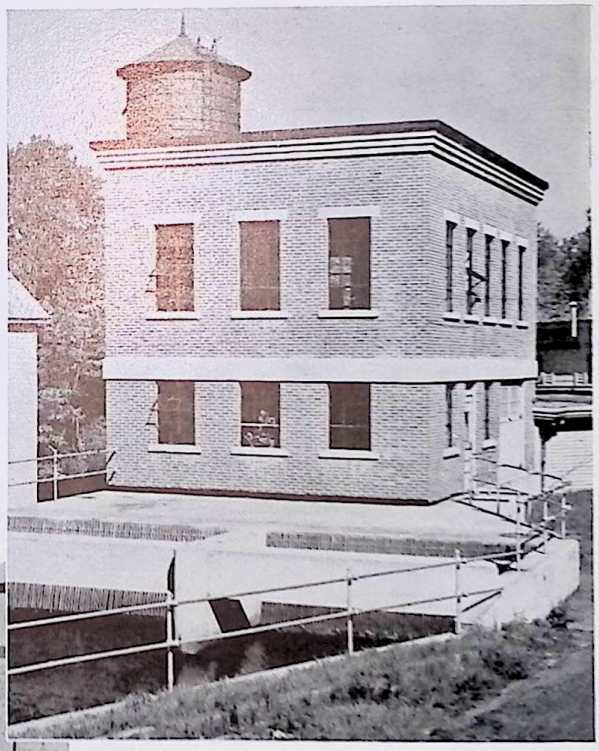
● Old Ellsworth, Maine, Plant of Bangor Hydro-Electric Corporation where two Francis turbines were replaced by a 60-inch diameter, 5-blade Smith-Kaplan turbine rated at 60 feet head, 2900 H.P., 360 R.P.M. The runner blades were pre-welded with stainless steel on the areas most susceptible to pitting.



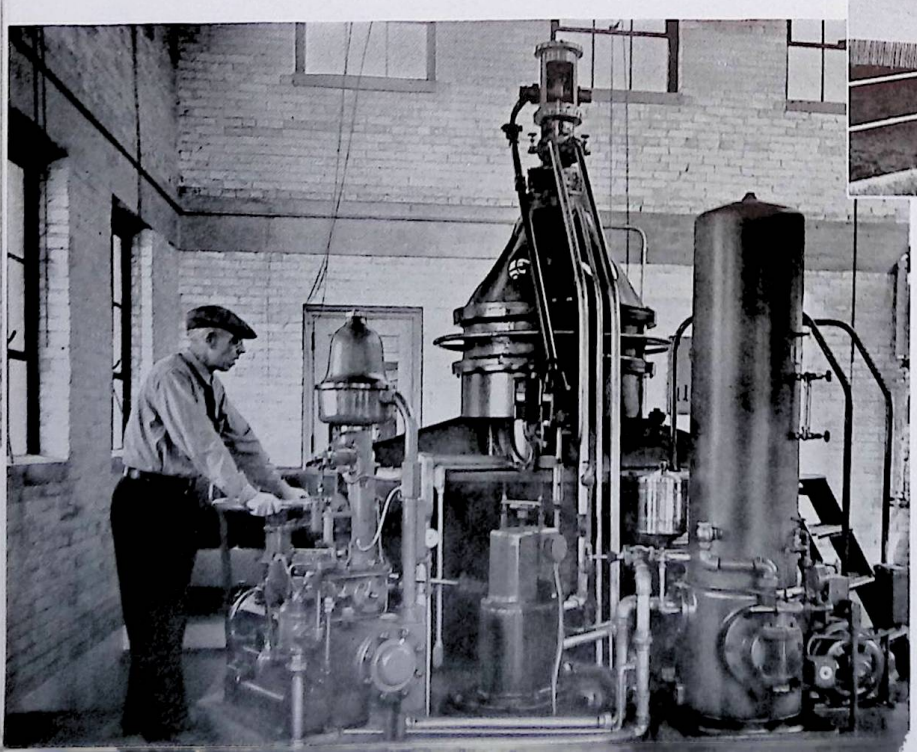
● Milford Station, another plant of Bangor Hydro-Electric Corporation in Maine. Three of the original Francis units have been replaced by 109-inch Smith-Kaplan turbines as part of a long-range plan for completely modernizing the plant. Each of the new units is rated at 2600 H.P. under 20 feet head, 120 R.P.M.



● Generator, Oil Supply Head and Governor at the Woolen Mill of Fred L. Emerson, Auburn, New York. The prime mover is a Smith-Kaplan turbine rated at 875 H.P. at 257 R.P.M. under 23 feet head. Note the absence of any speed element on the governor. The turbine wicket gates are controlled as a function of headwater level by means of a float connected to a regulating motor which moves the governor relay valve. A compensating motor opens the circuit to the regulating motor when the gates have reached the proper position corresponding to the water level.



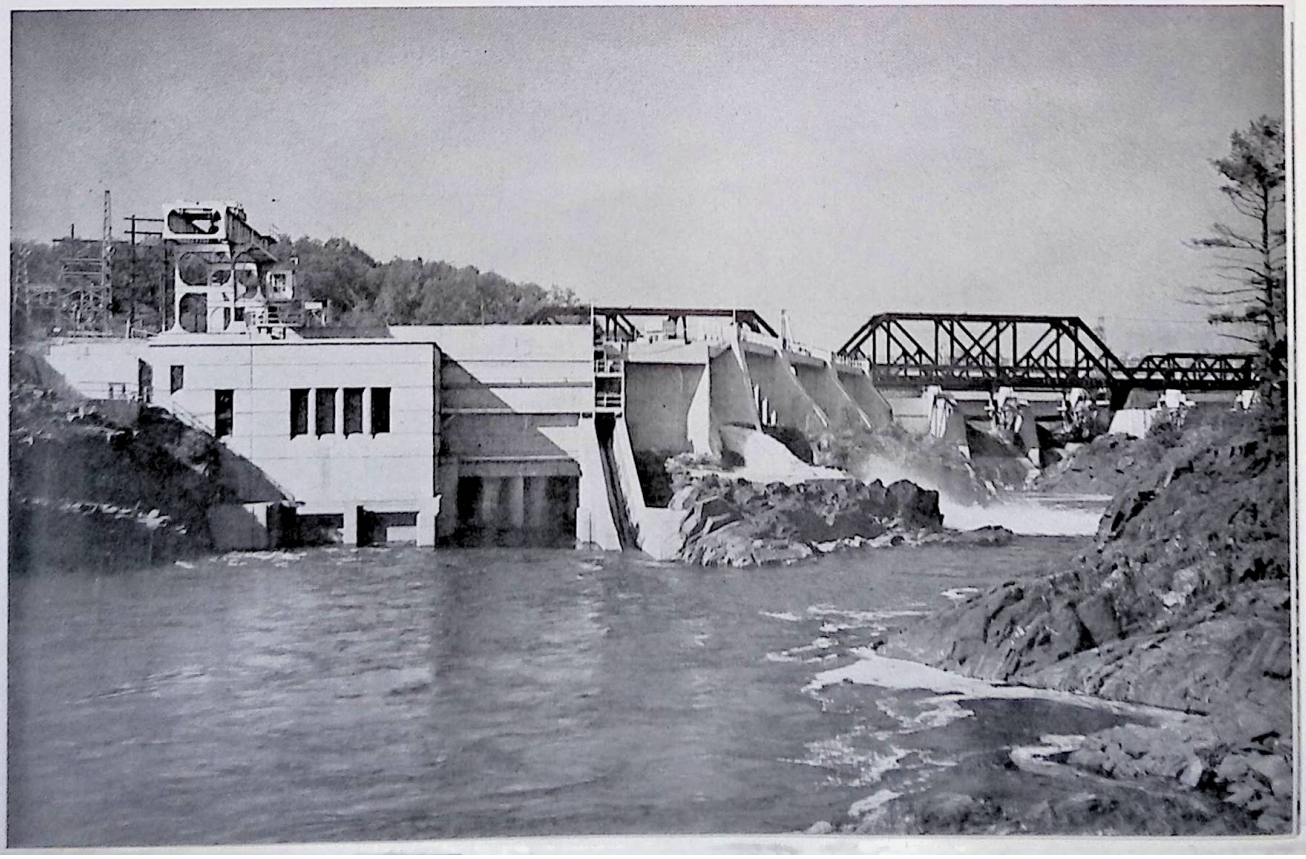
● An interesting example of a small single unit Smith-Kaplan turbine installation is that of Kezar Falls Woolen Company, in Maine, rated at 506 H.P., at 180 R.P.M., under 13 feet head.

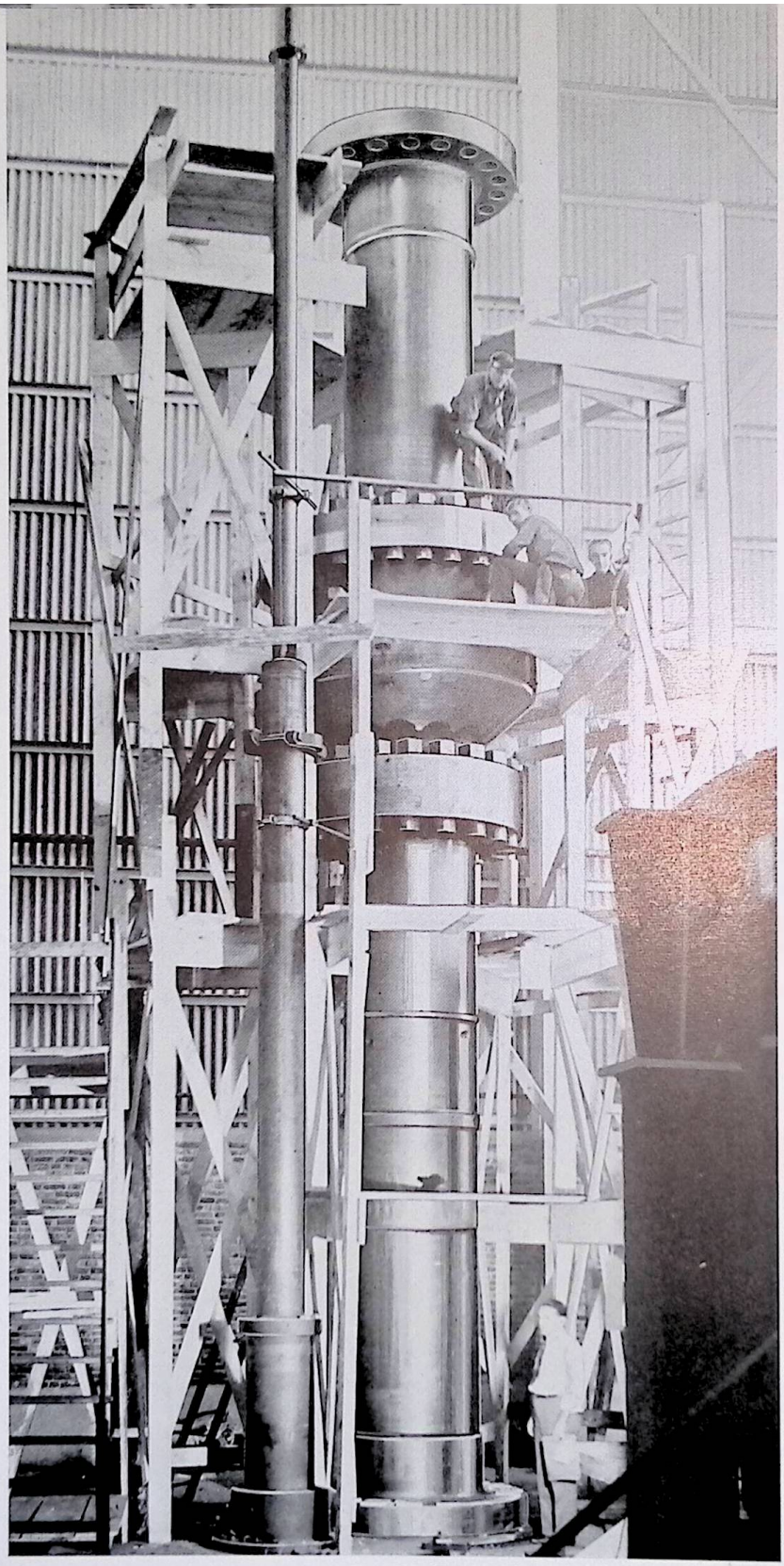


● This interior view of the Kezar Falls Station shows the compact arrangement of the controls.

● This 3780 H.P. turbine operating under 64 feet head is an important factor in the production of a large textile mill owned by the Ware Shoals Mfg. Co., Ware Shoals, South Carolina.

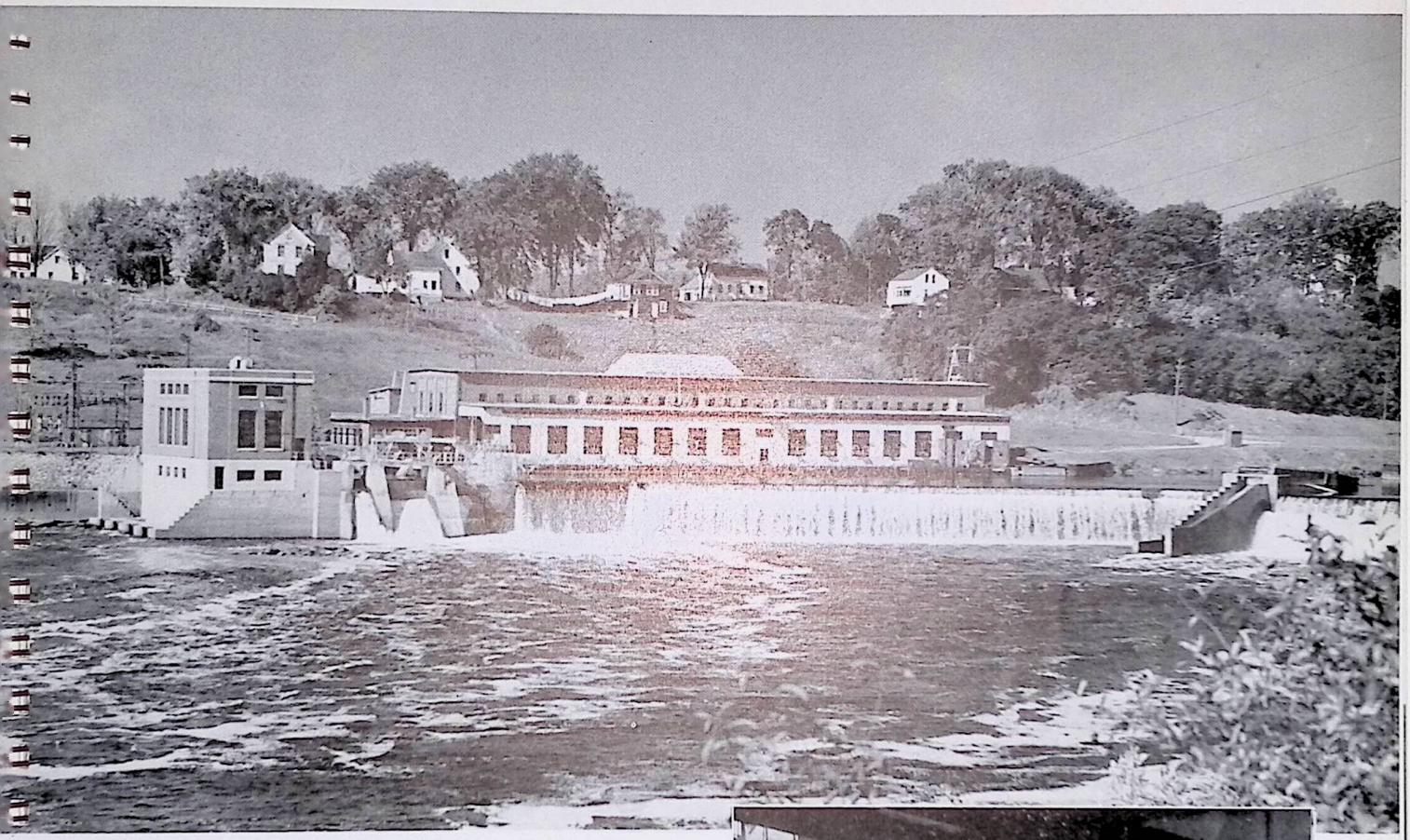
● This modern plant is that of the Central Maine Power Company, at Solon, Maine. It is equipped with a 10,150 H.P. Smith-Kaplan turbine operating at 150 R.P.M. under 42 feet head. A second unit is now being built by us.



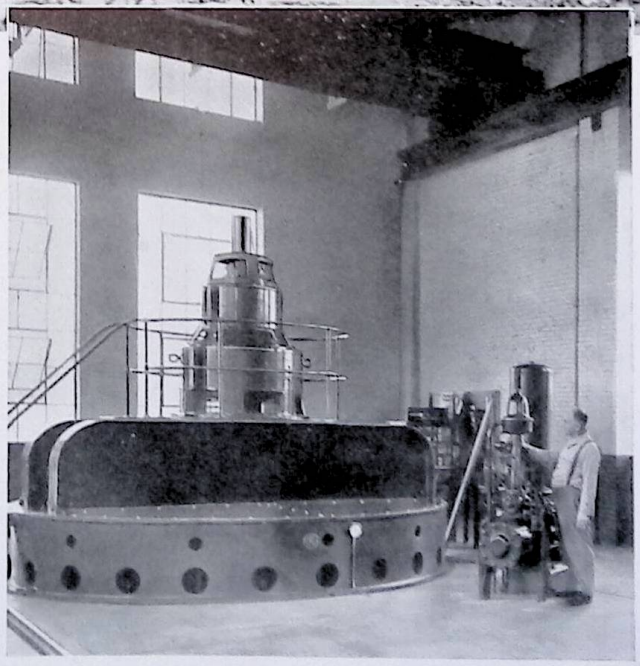


● Shafting section of one of the 74,000 H.P. Bonneville units assembled for checking on S. Morgan Smith Company's special shaft aligning device. This assembly is 33 feet 6 inches in height and the turbine shaft diameter is 3 feet 3 inches. The aligning device permits rotation of the combined turbine and generator shaft assembly in its operating position during shop tests and affords a positive check of alignment.

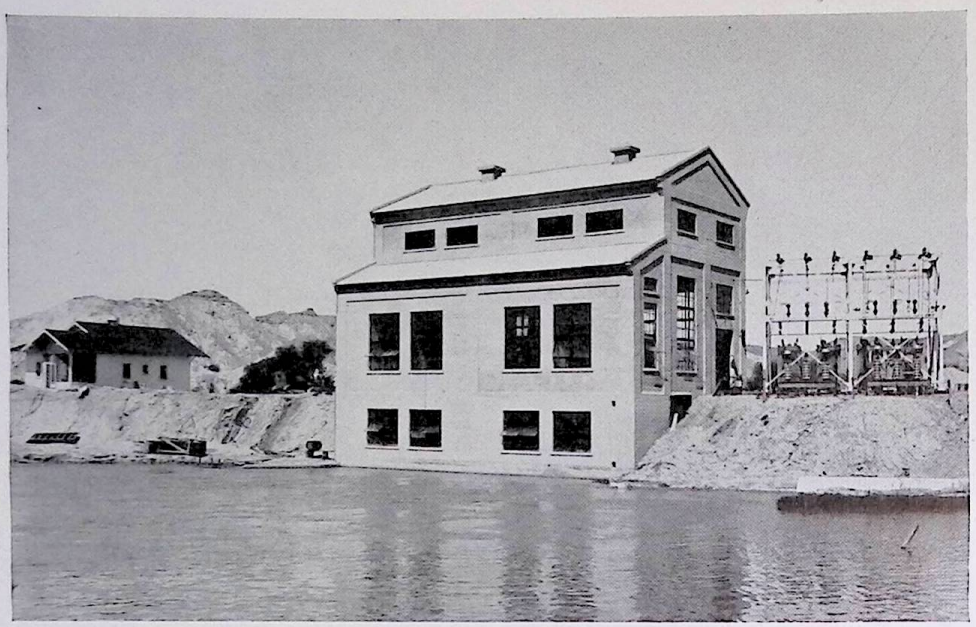
Fixed Blade Propeller Turbines



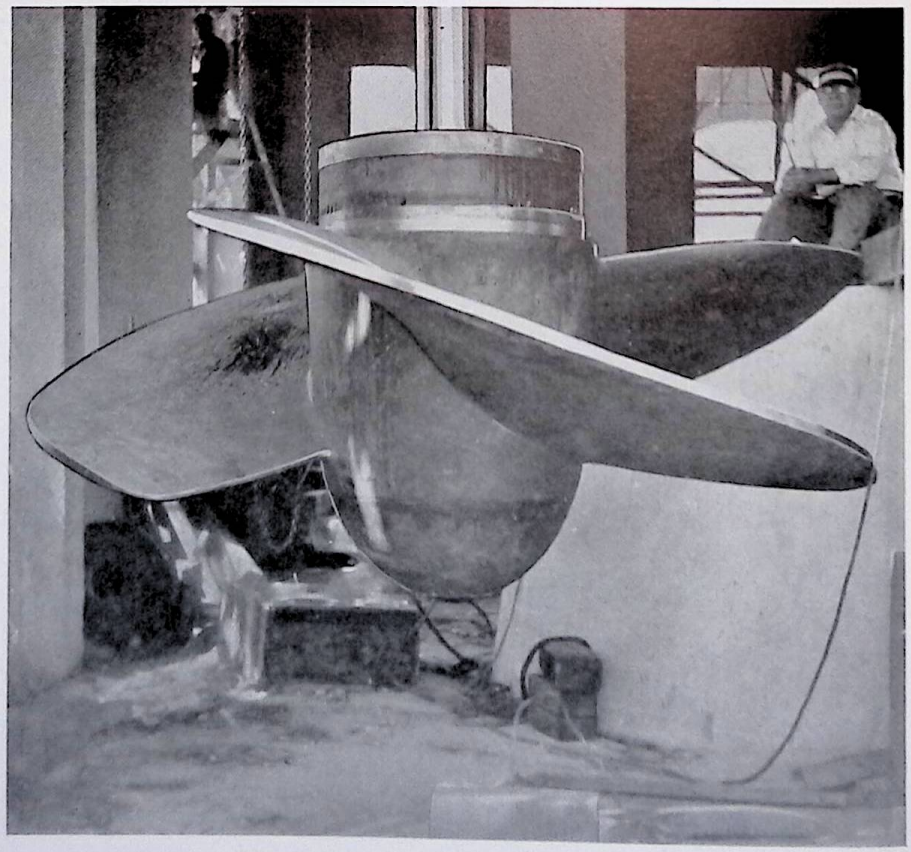
● At the Veazie Station, Maine, the Bangor Hydro-Electric Corporation built a new power house, shown at the left, to supplement the original development and installed two Smith Fixed Blade units rated at 2070 H.P. each at 128.6 R .P.M. under 20 feet head. The older Plant, shown in the center, contains fifteen high specific speed Francis turbines, a few of which have been remodeled with Francis runners of more modern design.



● Interior of the new power house.

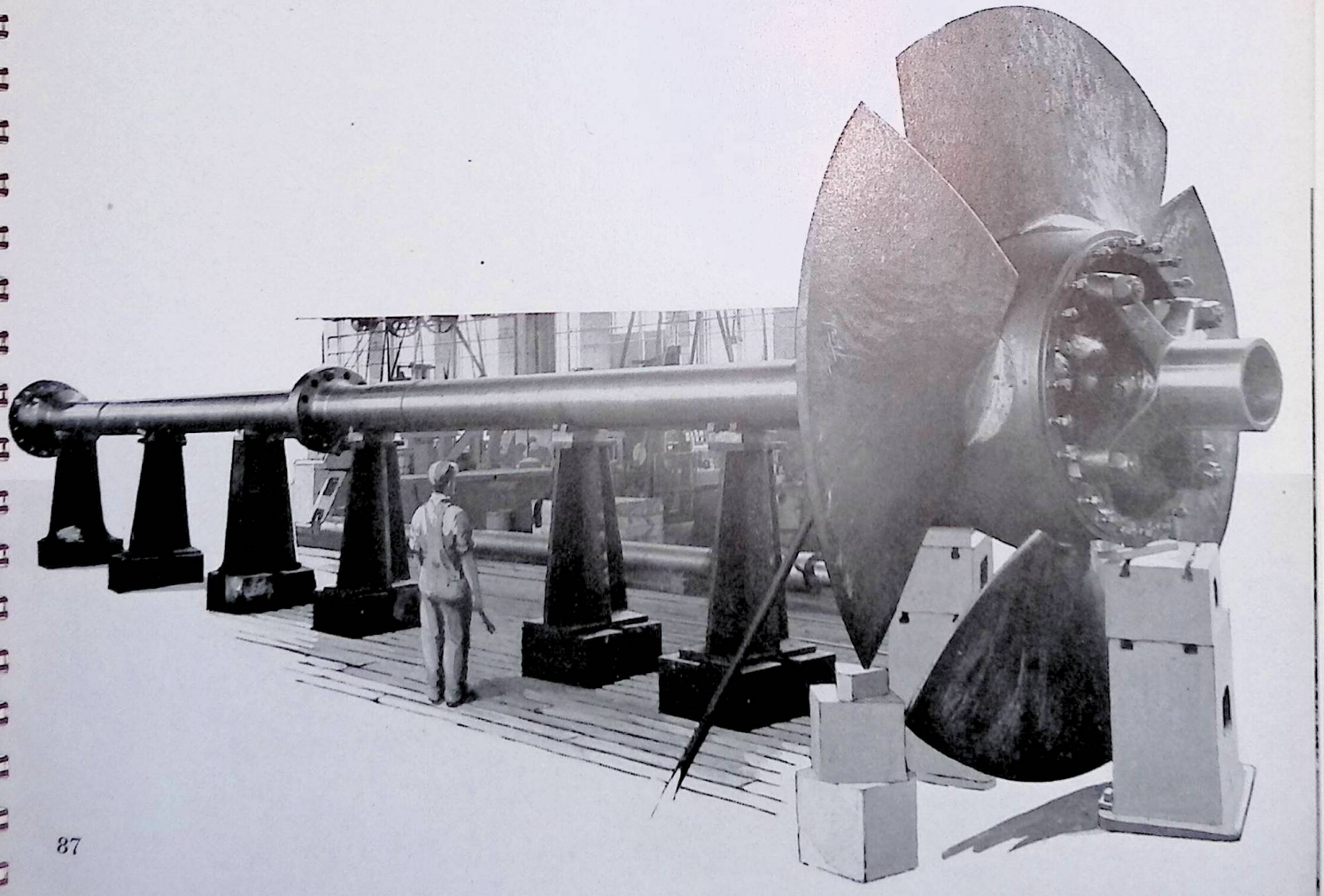


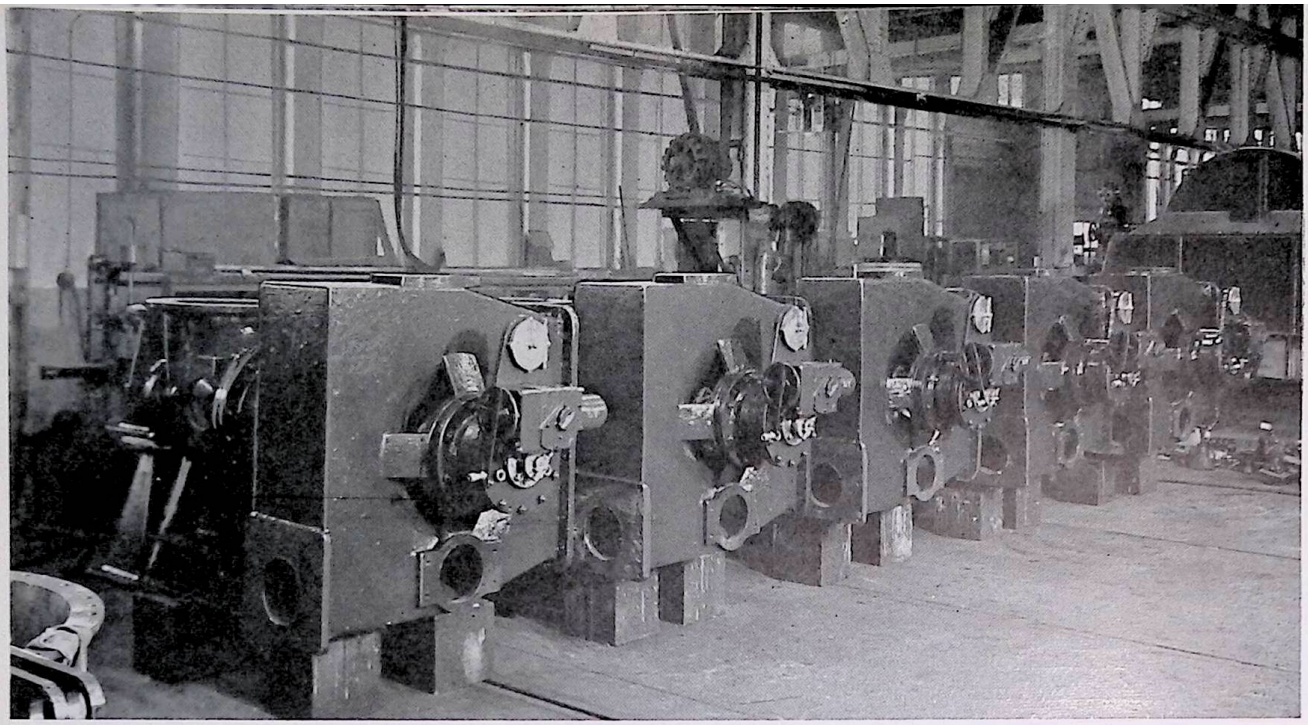
● U.S. Department of the Interior, Bureau of Reclamation, Yuma Project, Arizona. The Siphon Drop Power Plant contains three Smith Fixed Blade Propeller turbines rated at 1160 H.P., at 112.5 R.P.M., under 14 feet head.



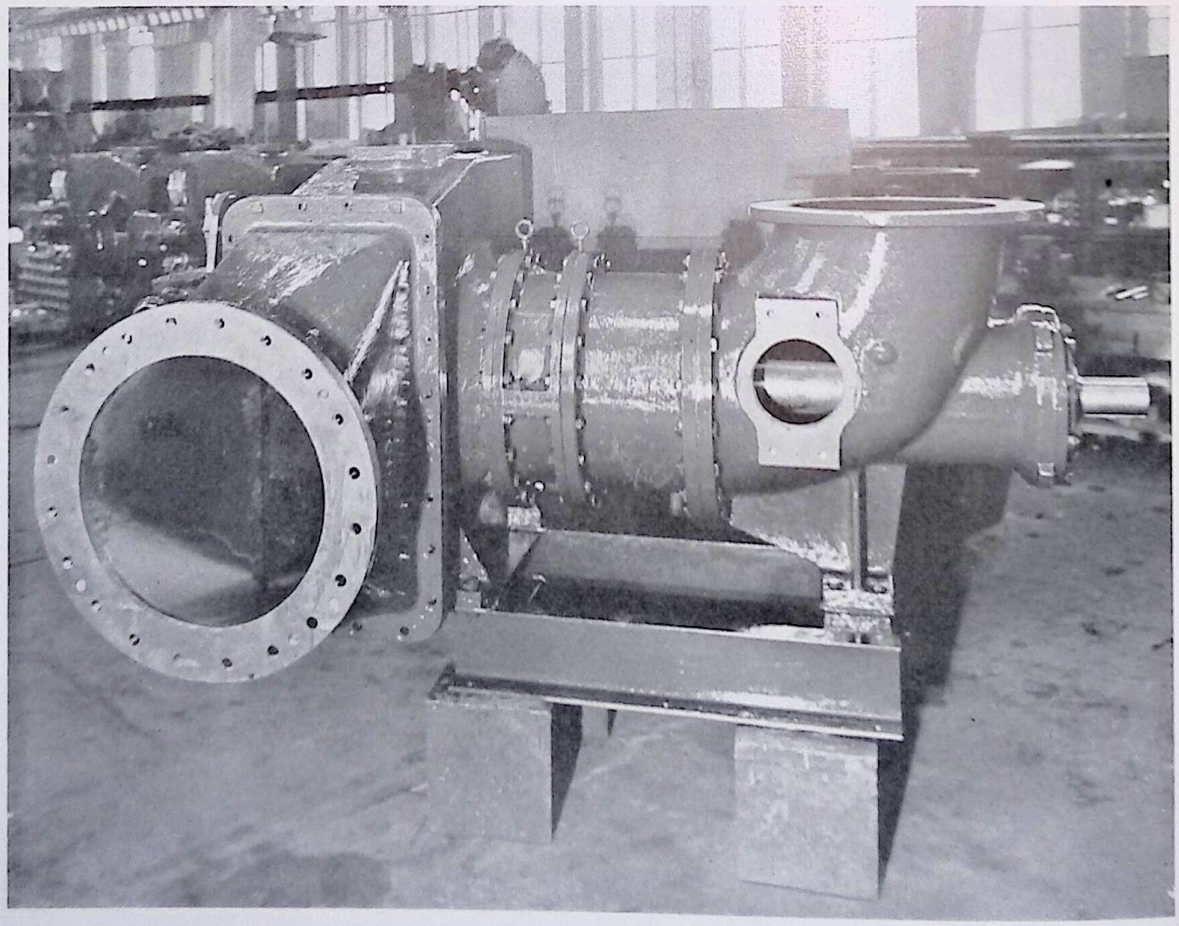
Automatically Adjustable VANE Impeller PUMPS

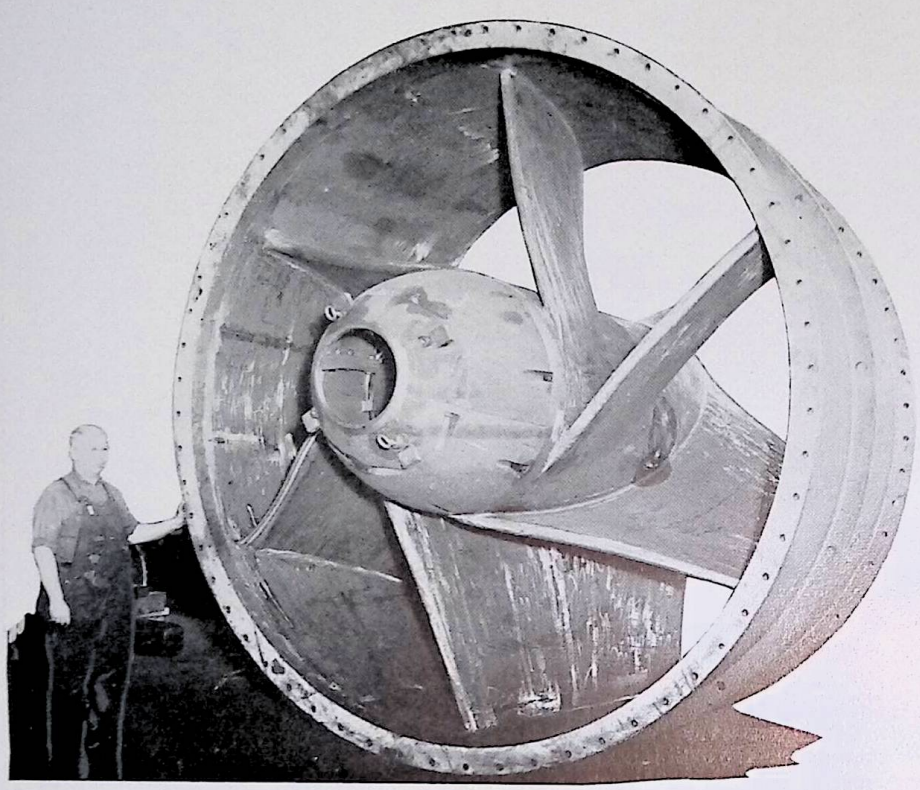
THE Automatically Adjustable Vane Impeller Axial Flow Pump permits varying the discharge by changing the pitch of the impeller vanes, while the pump is operating. This feature is especially advantageous and useful where low varying heads and high volume requirements prevail, such as are met in flood control, irrigation, sanitation and many industrial projects.





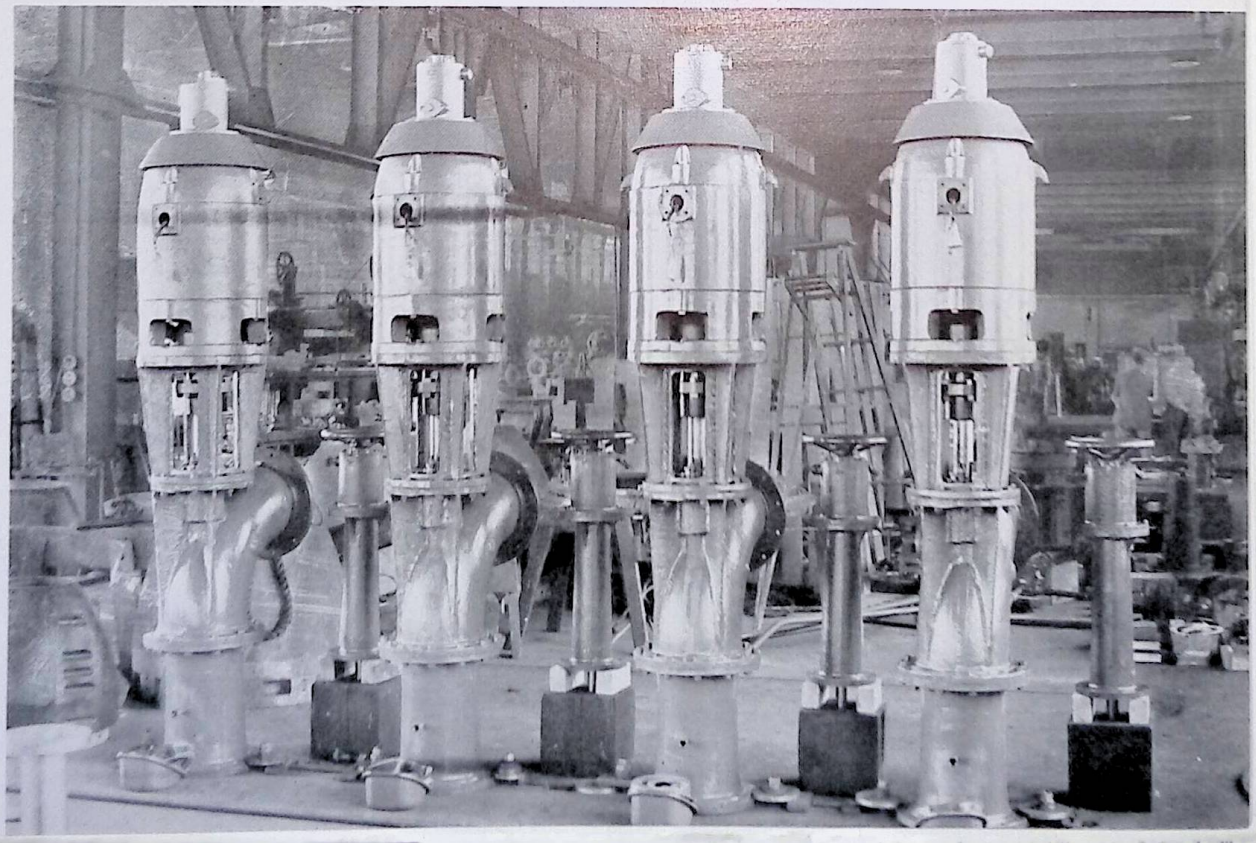
● These five horizontal adjustable vane pumps are used for pumping paper stock in the Fitchburg, Massachusetts, paper mill of Crocker-Burbank Corp. They are each rated at 8000 G.P.M. at 720 R.P.M. 16 feet T.D.H. The impeller vanes are operated by a motor controlled manually from a remote push button station. Below, discharge through the pump is from left to right.

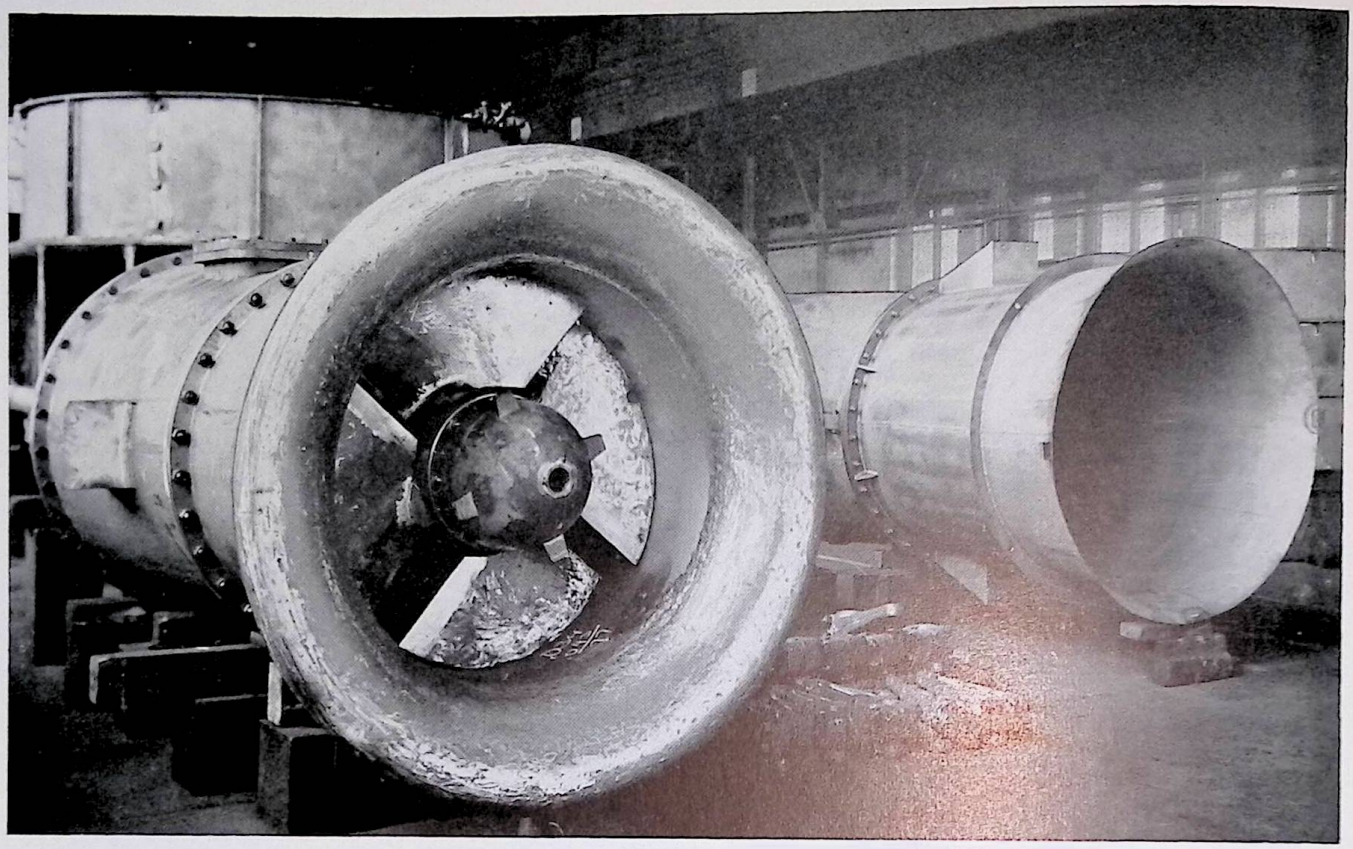




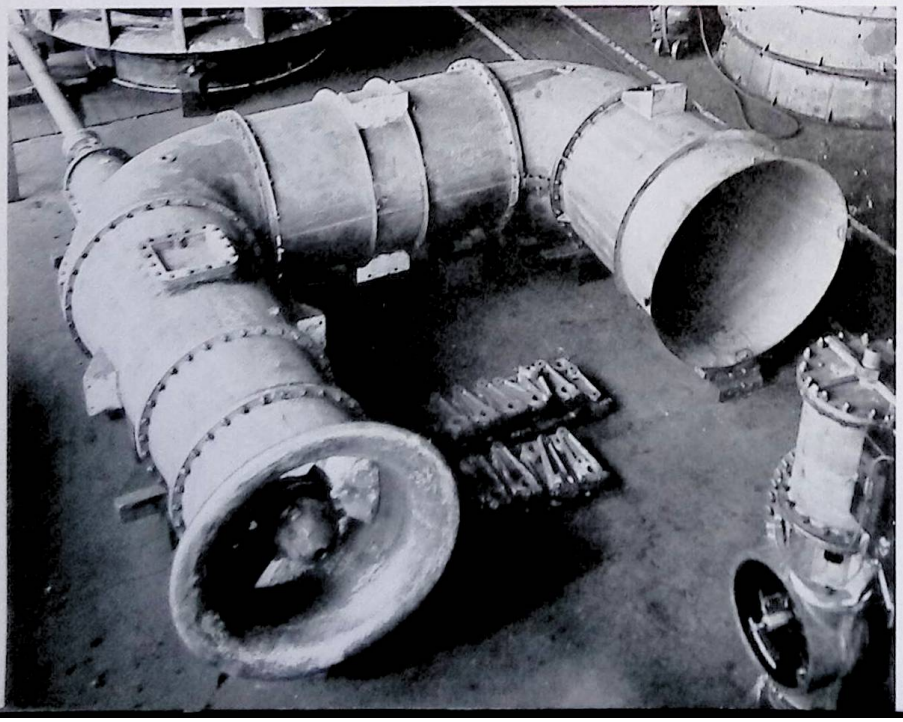
● Diffuser casting of a large Axial Flow Pump.

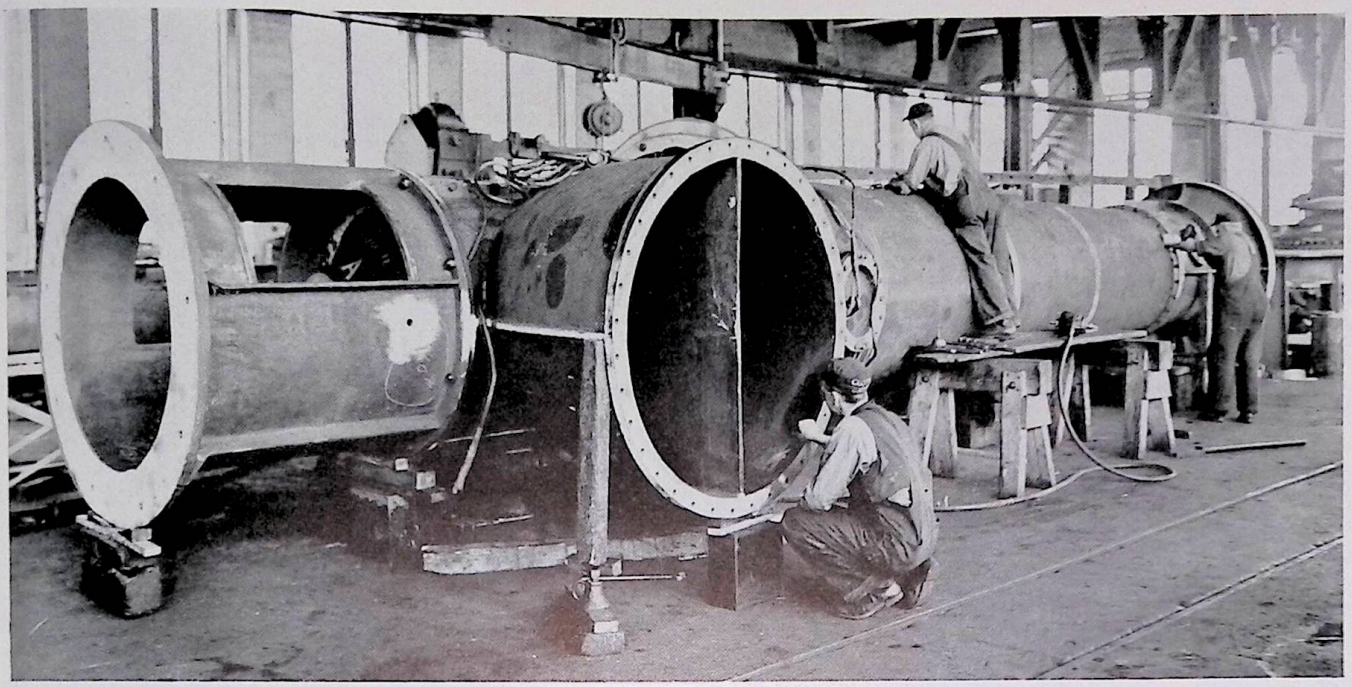
● A group of low-capacity, self-contained Adjustable Vane pumping units.





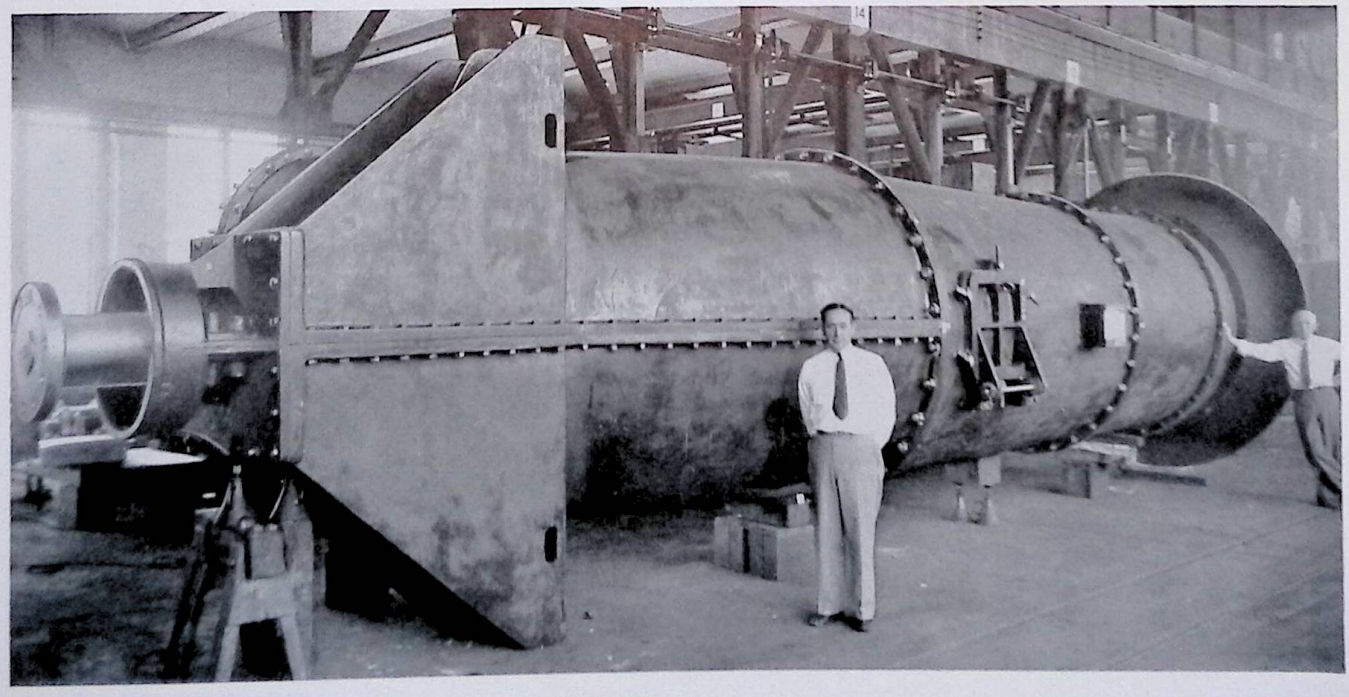
● Two views of a low head Adjustable Vane Pump for regulating level of a water-storage reservoir at Sioux City, Iowa. Each of the two units is designed to operate at heads up to six feet. The Adjustable Vane feature provides a very flexible pump, vanes being at maximum pitch at the low heads and reduced pitch at maximum head to prevent overloading the motor. Adjustment of the impeller vane angle is effected by a worm gear reduction mounted on top of the driving motor and operated by a handwheel. Discharges up to 60,000 G.P.M. may be attained.

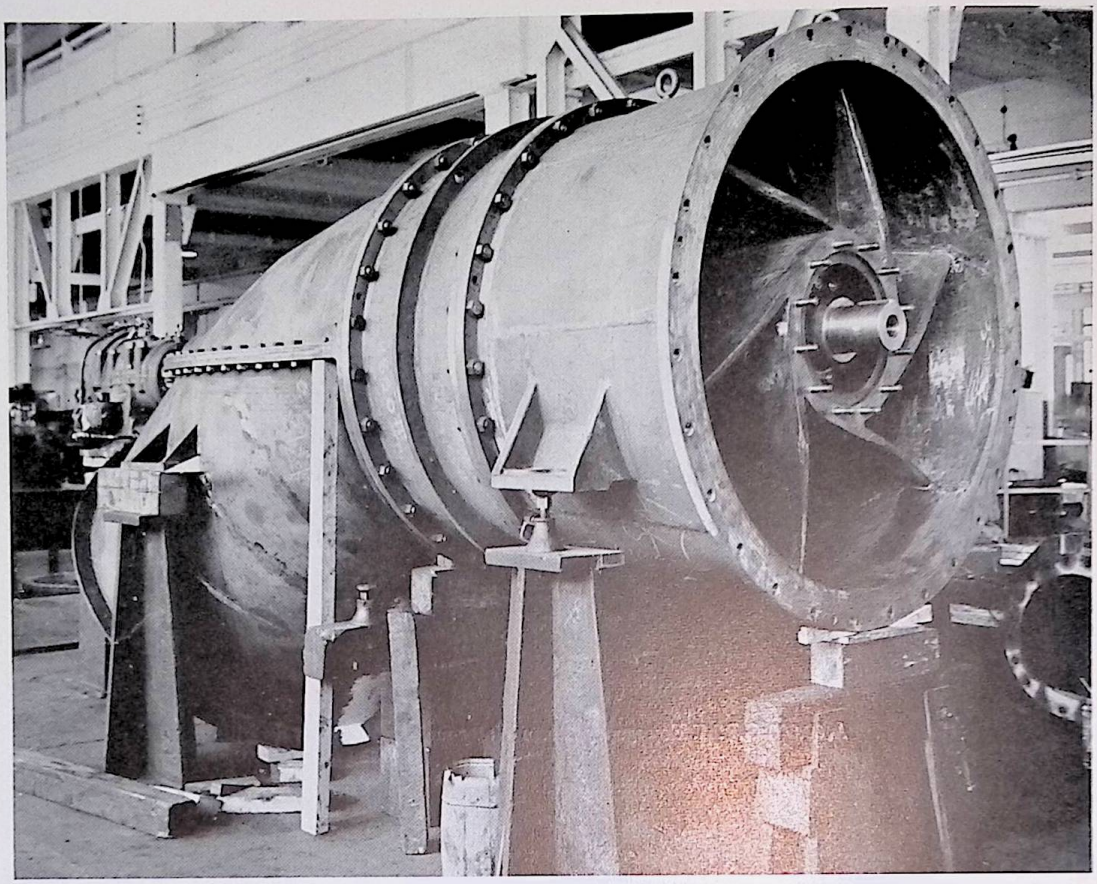




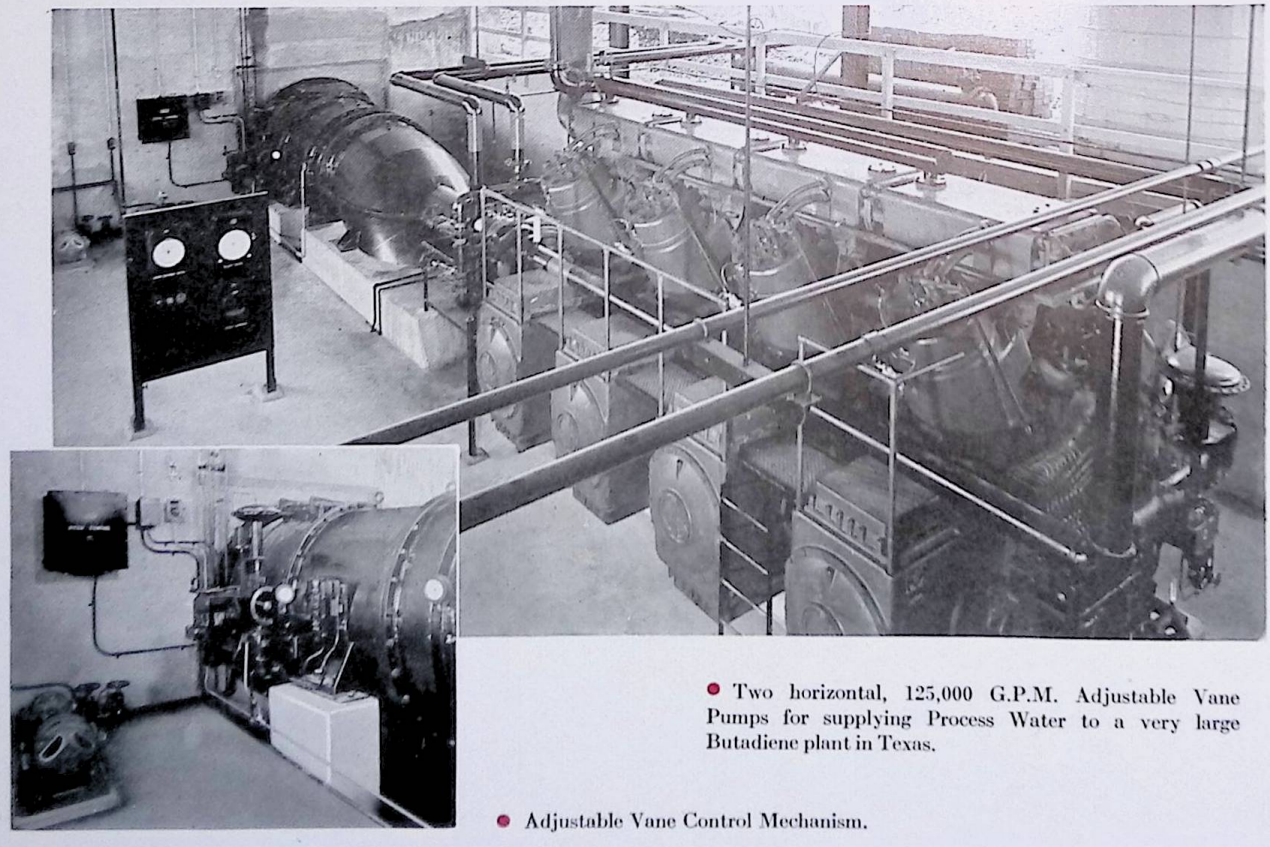
A 60,000 G.P.M. Emergency Storm Water and Sanitary Sewage Pump.

A 247,500 G.P.M. Vertical Pumping Unit.





● Shop assembly of diffuser section and suction elbow.

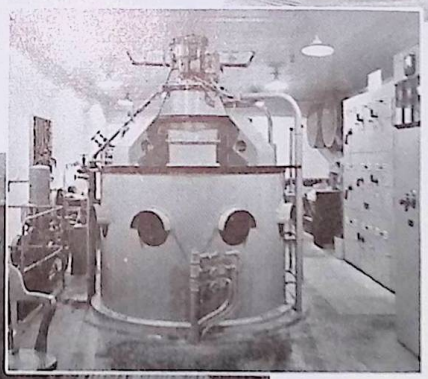


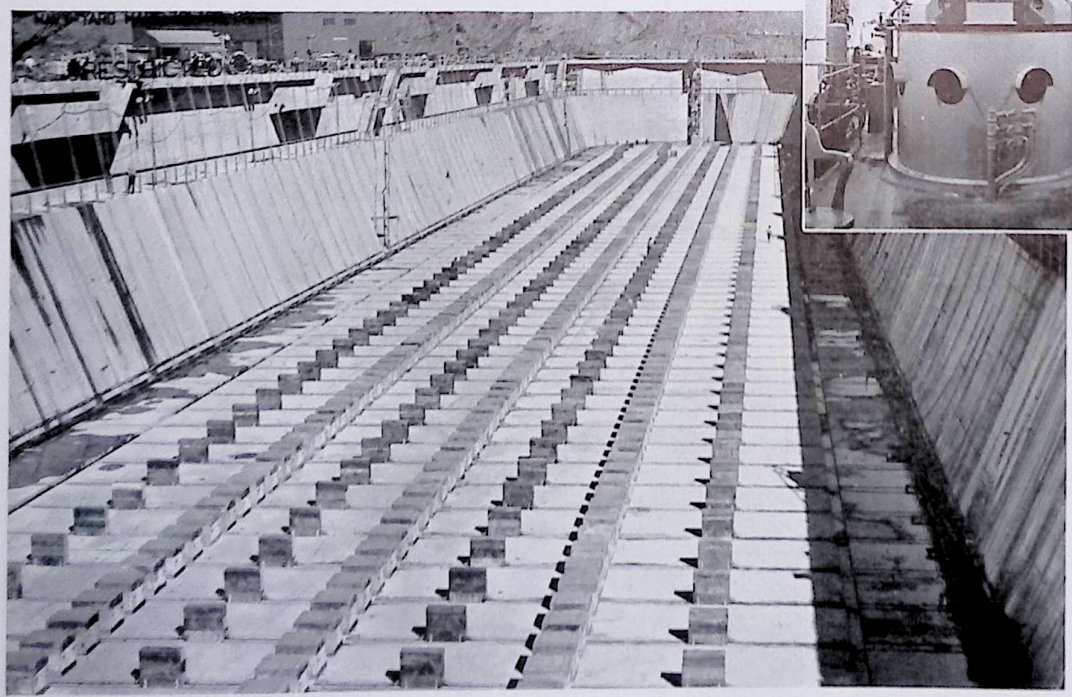
● Two horizontal, 125,000 G.P.M. Adjustable Vane Pumps for supplying Process Water to a very large Butadiene plant in Texas.

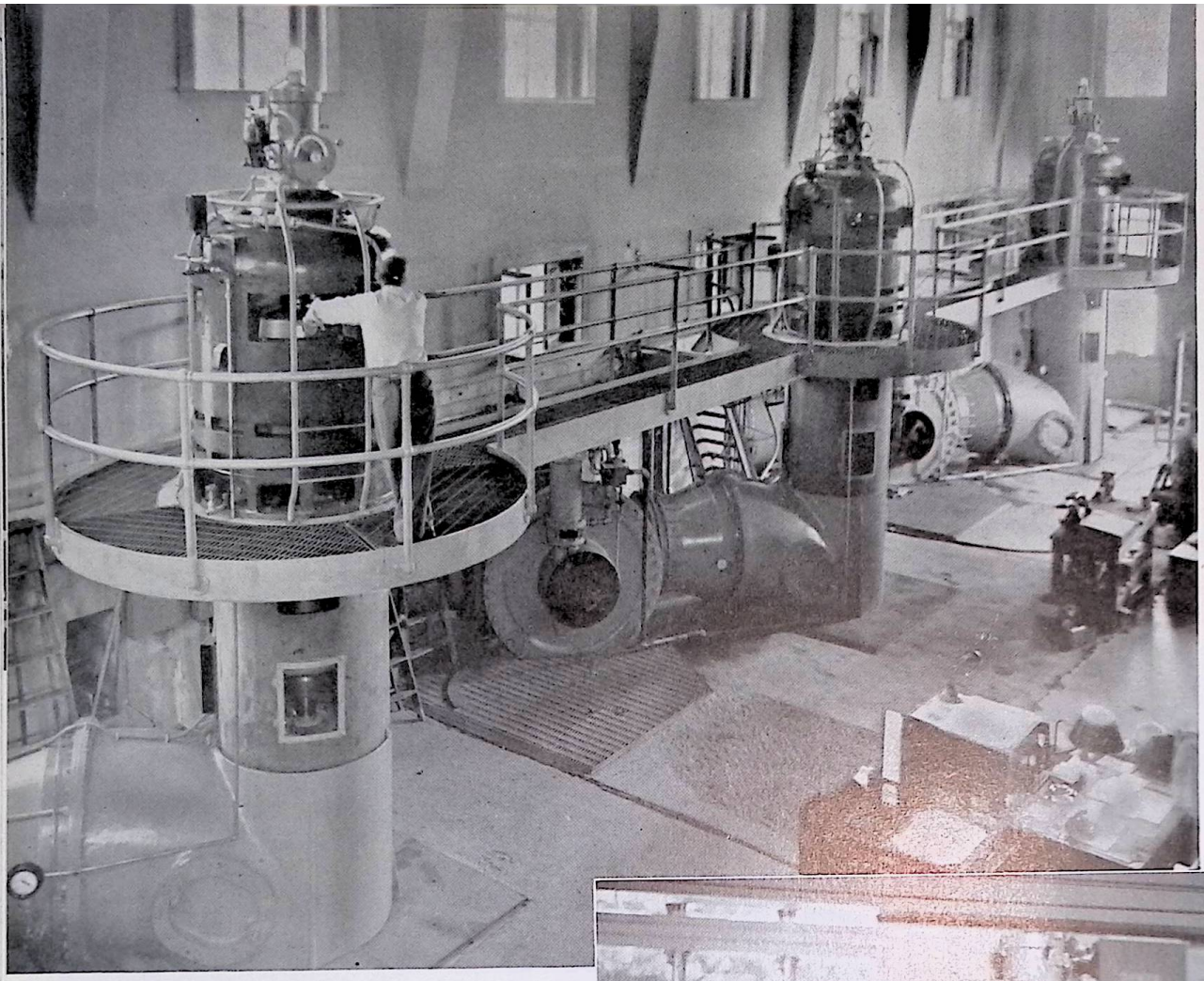
● Adjustable Vane Control Mechanism.

● Impellers of pumps for operation under a head varying between 15 and 55 feet in Dry Dock Service.

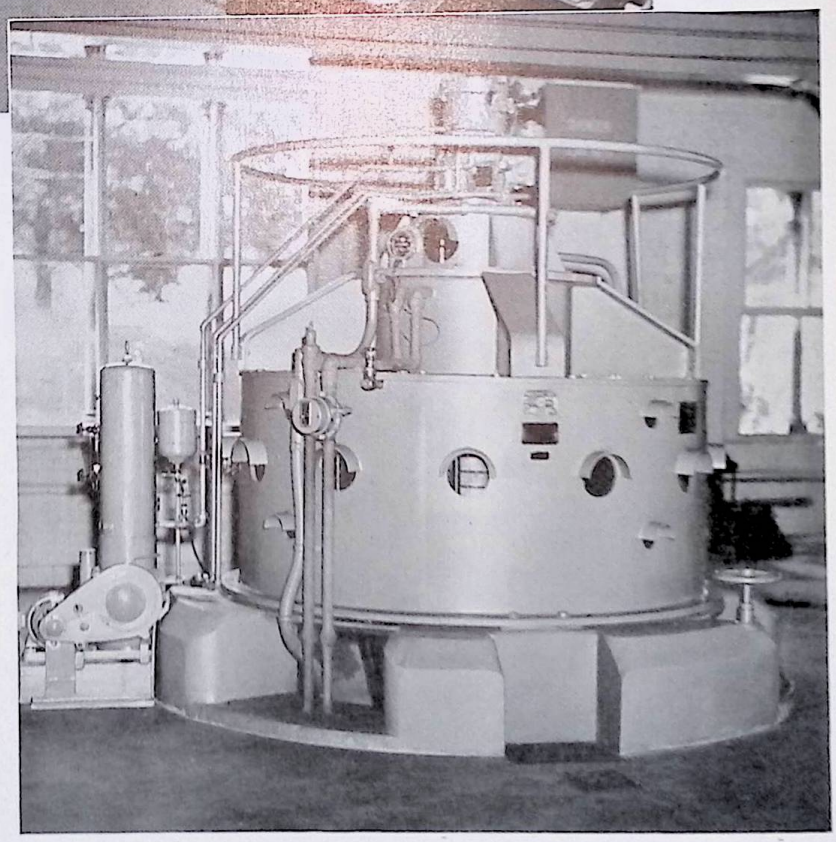
● Smith Adjustable Vane Pumps are used to dewater this large Naval Dry Dock located on the West Coast.



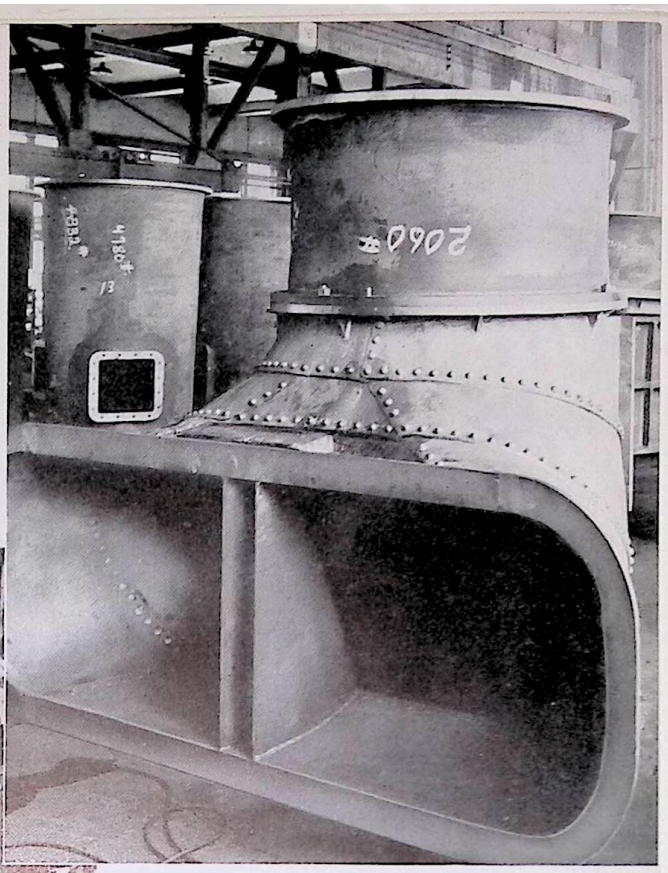




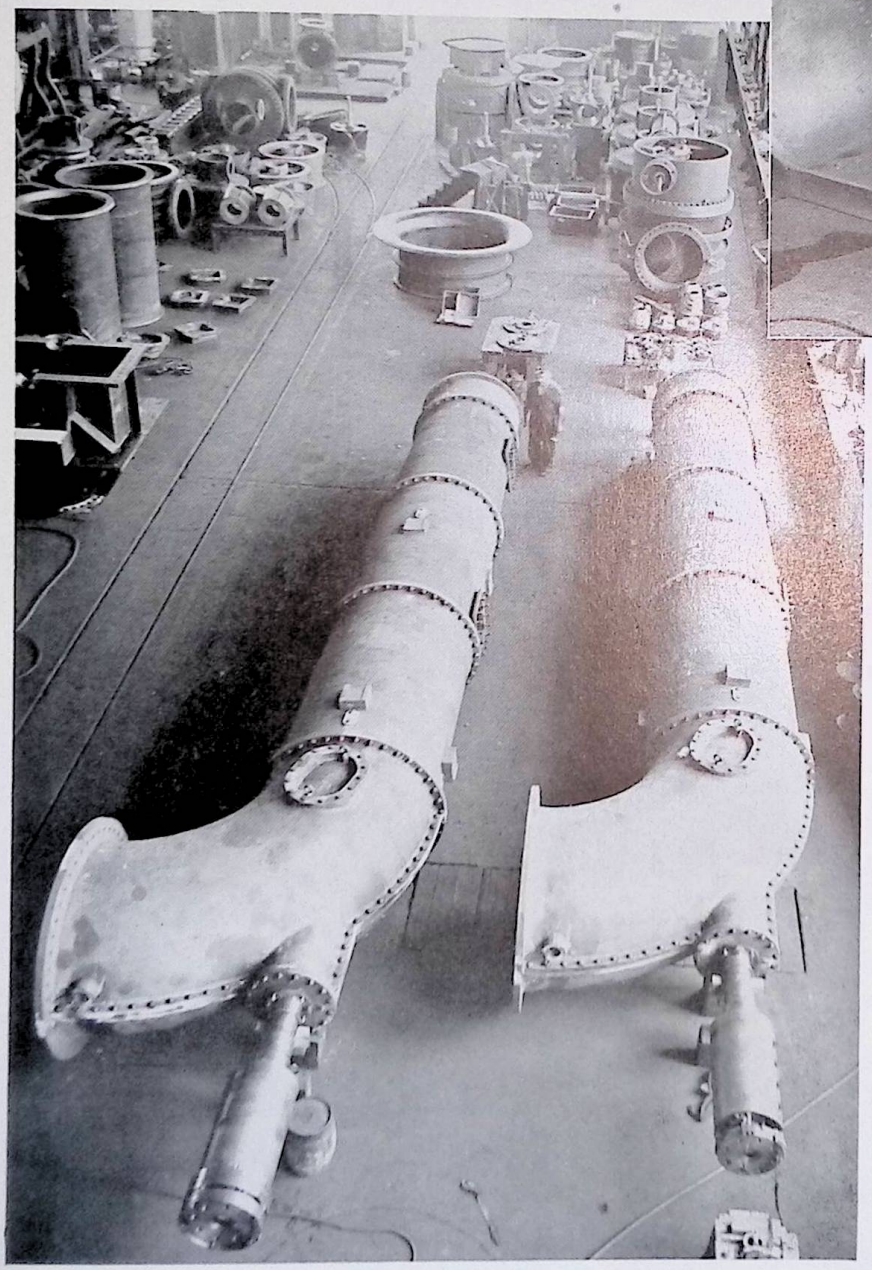
● Three Smith Adjustable Vane Pumps in the McMillan Reservoir Filter Pumping Station of the U.S. War Department, Washington, D.C. They are operated at 600 R.P.M. by 700 H.P. motors and discharge 75 M.G.D. at heads varying from 27 to 40 feet. The impellers are 37 inches in diameter with stainless steel vanes and bronze hubs.



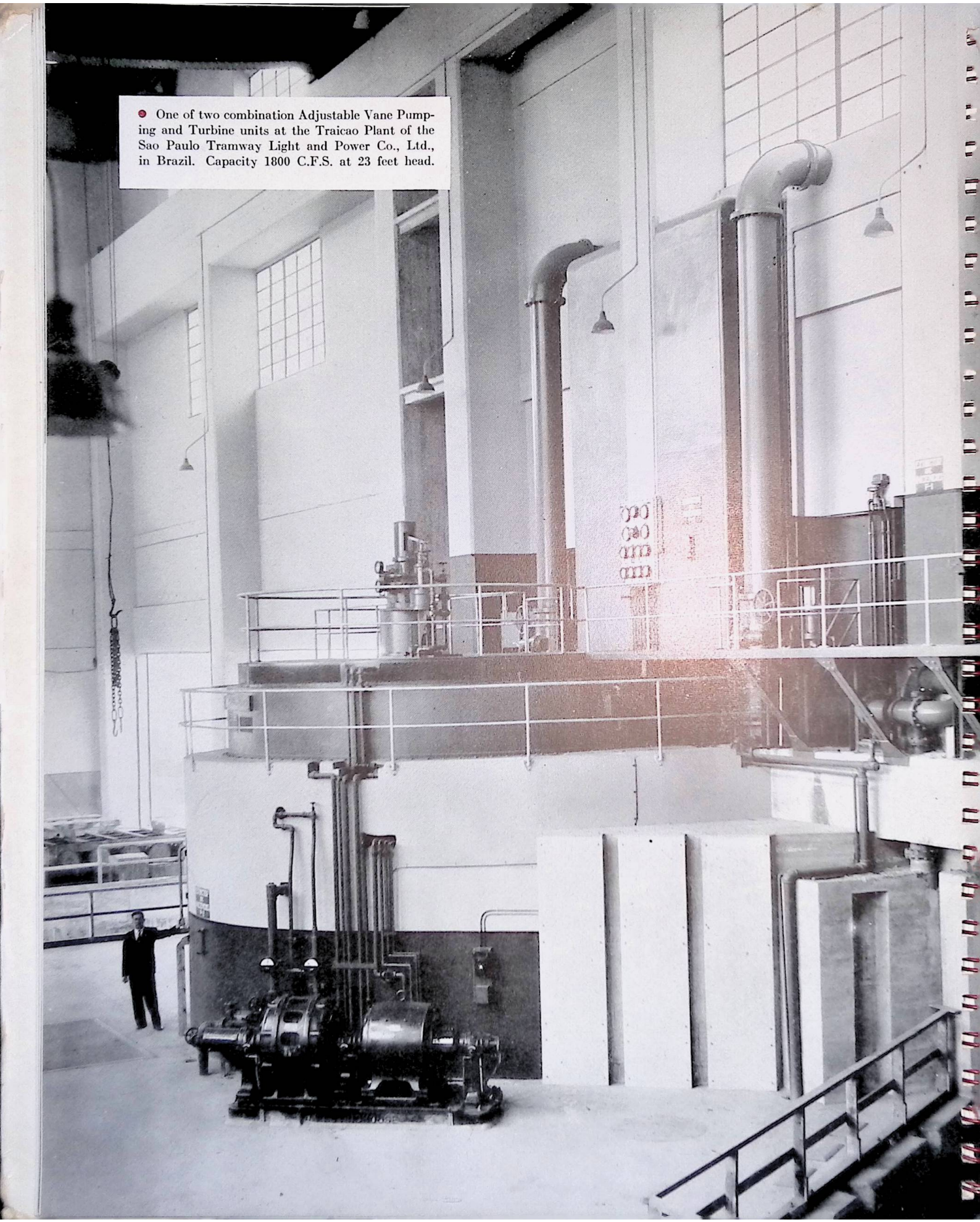
● This Adjustable Vane Pump is in the McMillan Reservoir Booster Station. The head varies from 5 to 30 feet. The pump is powered by a 1000 H.P. motor and discharges 125 M.G.D. at 30 feet head.



● Intake elbow of one of four 83,000 G.P.M. Adjustable Vane Pumps used for steam turbine condenser service by the Union Electric Co., of Illinois, at their Venice No. 2 Station. Maximum head 45 feet. Motor capacity 1400 H.P. Four additional units are now under construction.

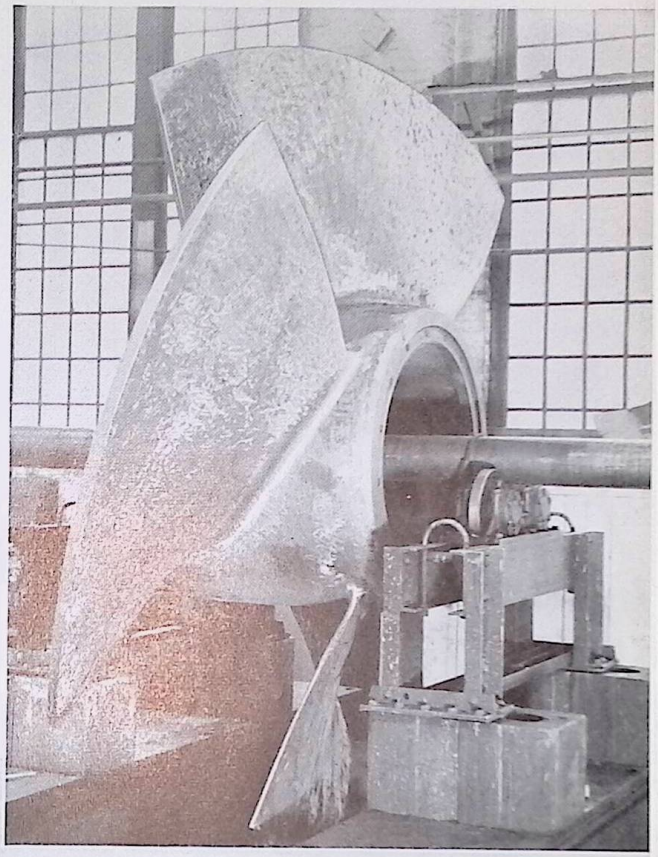


● Assembly of column and shafts for two of the above units.



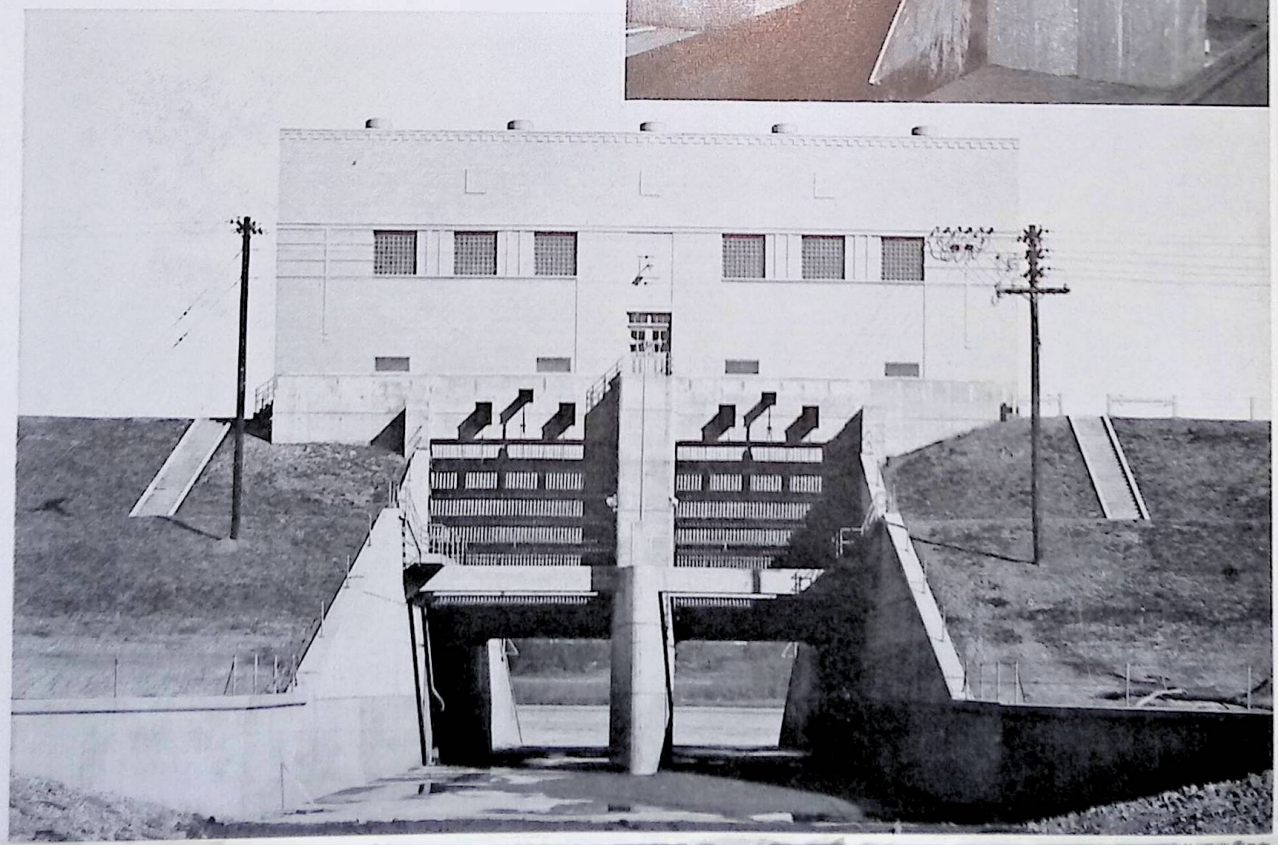
One of two combination Adjustable Vane Pumping and Turbine units at the Traicao Plant of the Sao Paulo Tramway Light and Power Co., Ltd., in Brazil. Capacity 1800 C.F.S. at 23 feet head.

FIXED VANE PUMPS



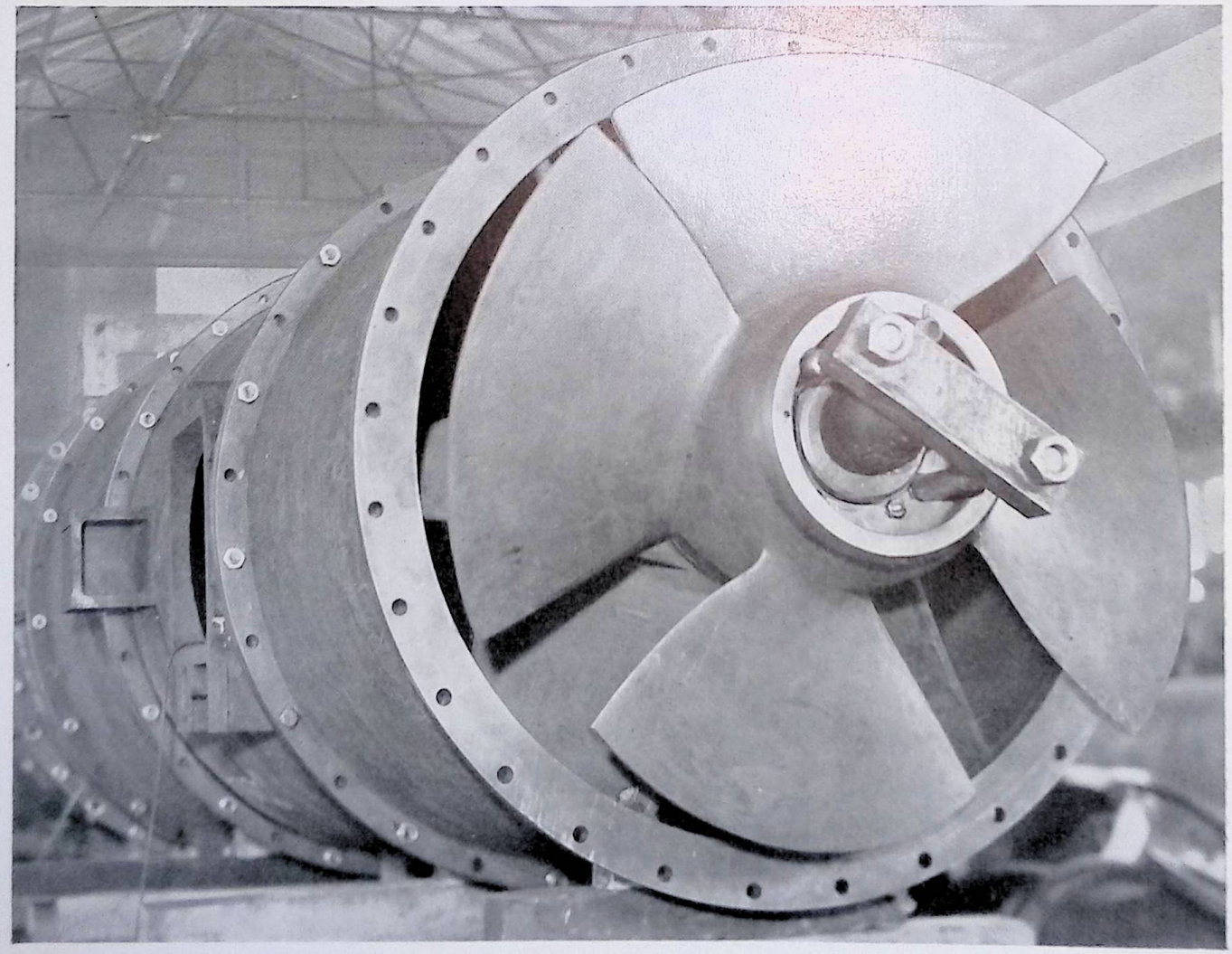
● Shop view of Fixed Vane Pump Impeller 120 inches in diameter being checked for static balance.

● Fourpole Creek Pumping Station and Inlet Structure with trash racks raised. Normally, Fourpole Creek flows through this opening into the Ohio River seen in the background. However, during high water the gates in this passageway are closed, the trash racks lowered, the three 181,000 G.P.M. pumps started and floods on the Fourpole Creek averted or greatly reduced.



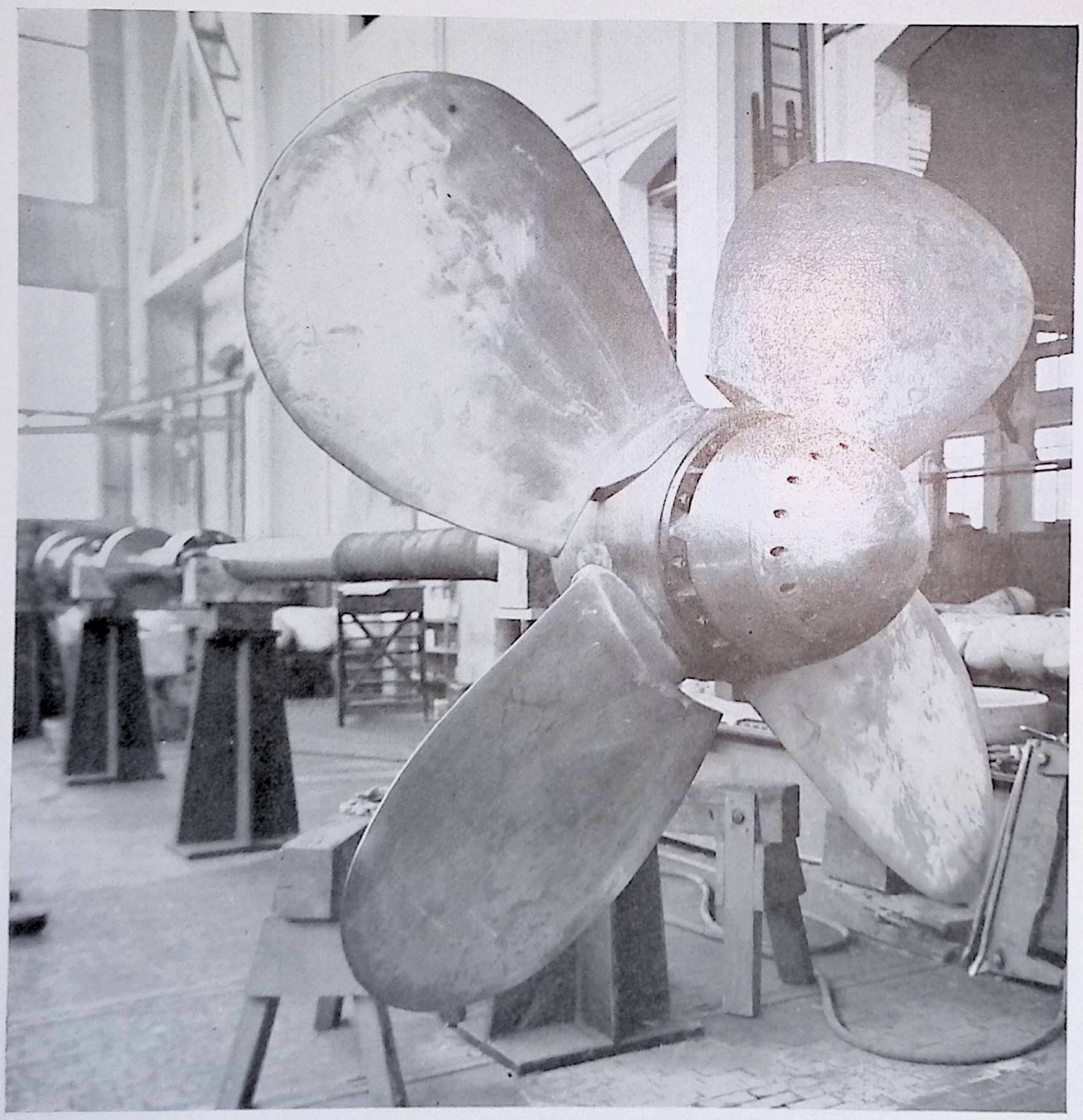
● Barrier Dam Emergency Pumping Plant on Mill Creek, shown at left, City of Cincinnati, Ohio, where six Smith Fixed Vane Pumps were installed as part of a flood relief project. Each pump is rated at 684,000 G.P.M. at 29 feet head and is driven by a 6500 H.P. motor at 180 R.P.M.

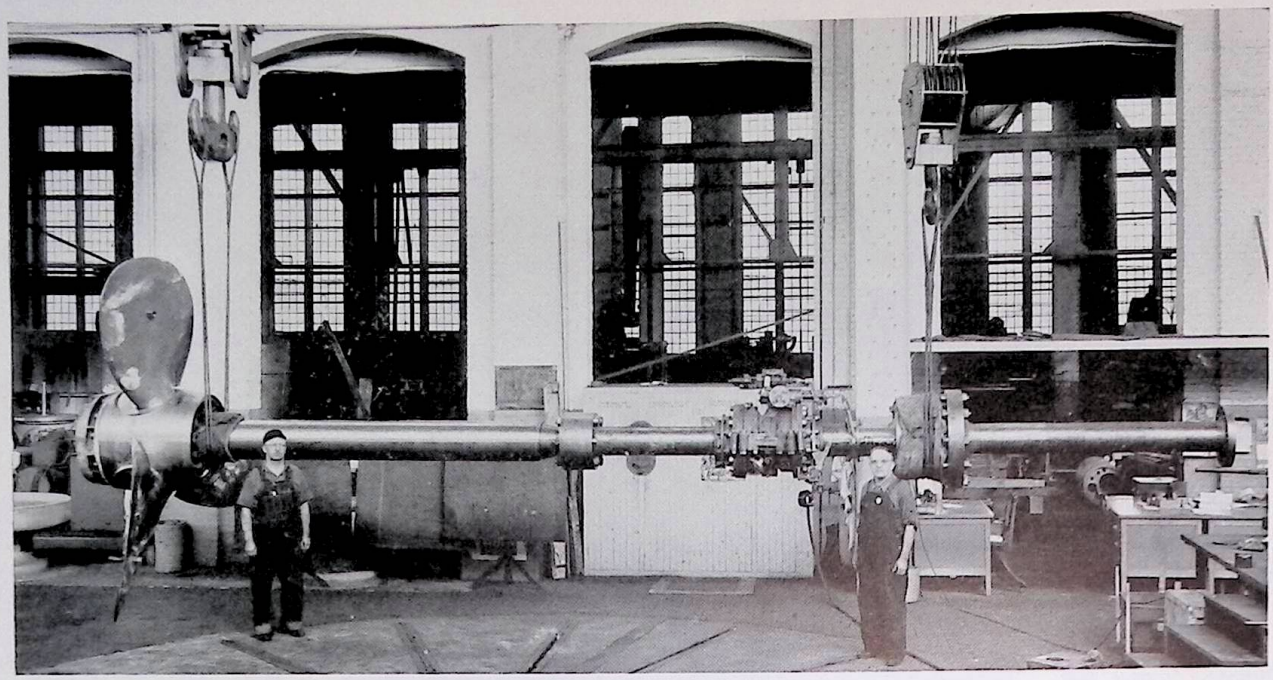
● Shop assembly of 61½-inch Fixed Vane Pump. The impeller is being jacked off the shaft.



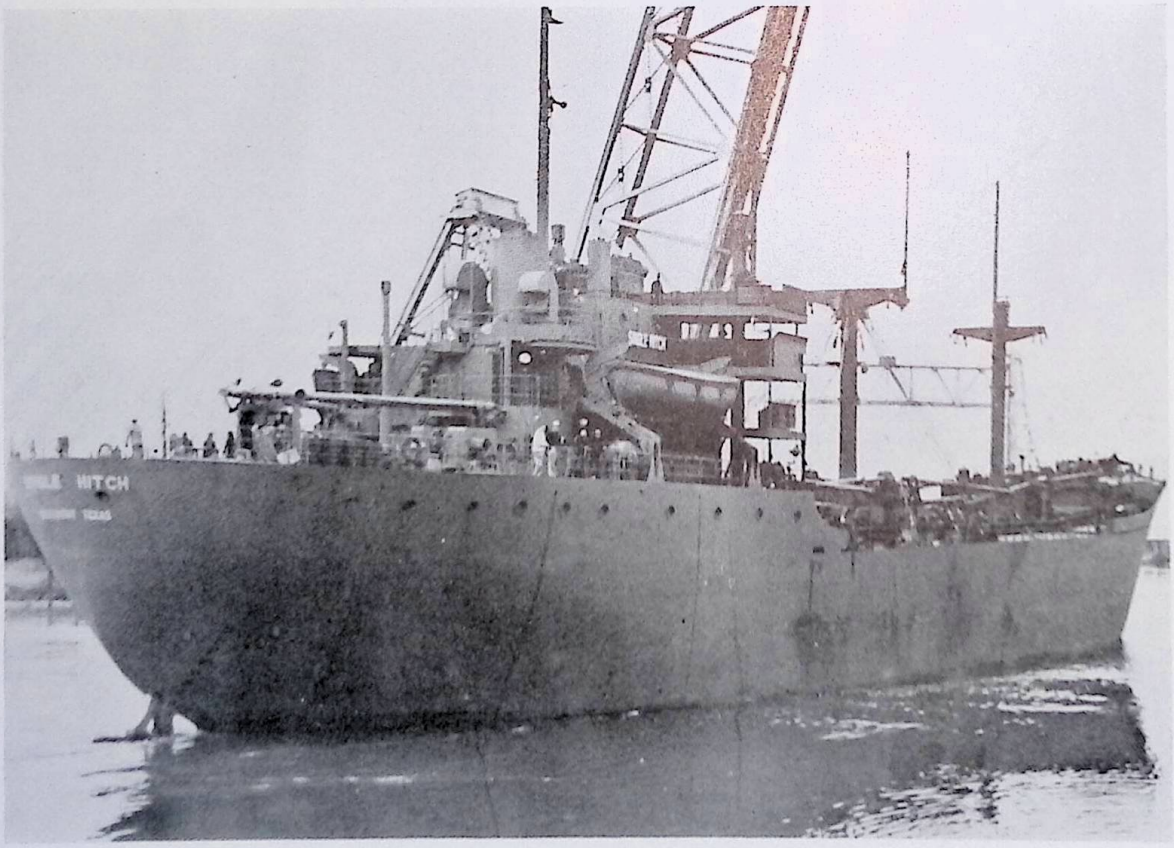
Controllable PITCH SHIP Propellers

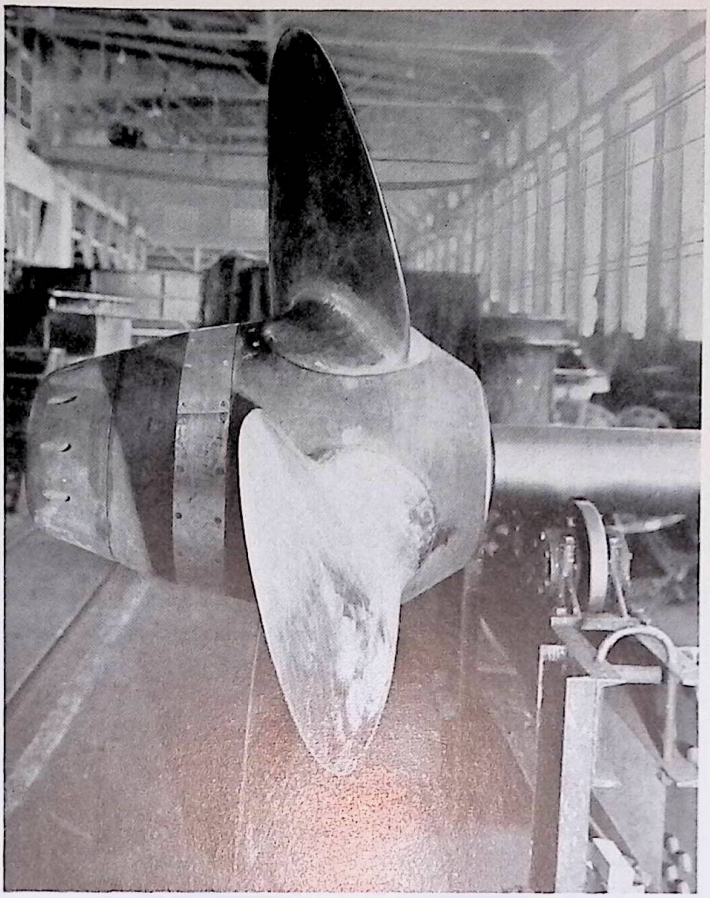
● Stern view of 114-inch Controllable Pitch unit for installation on the Y T B 505, U.S. Bureau of Ships. 174 R.P.M., 965 S.H.P.



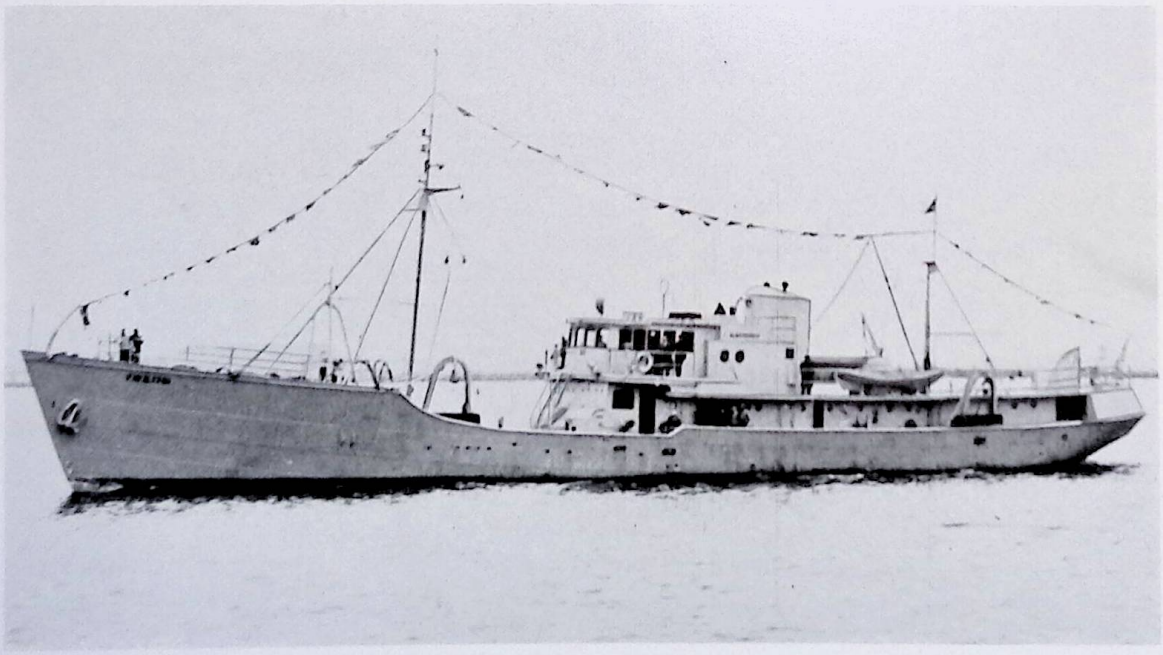


● Eleven-foot diameter propeller, shaft and blade operating mechanism for installation on the U.S. Maritime Commission's "Single Hitch." Speed 180 R.P.M., 1700 S.H.P.

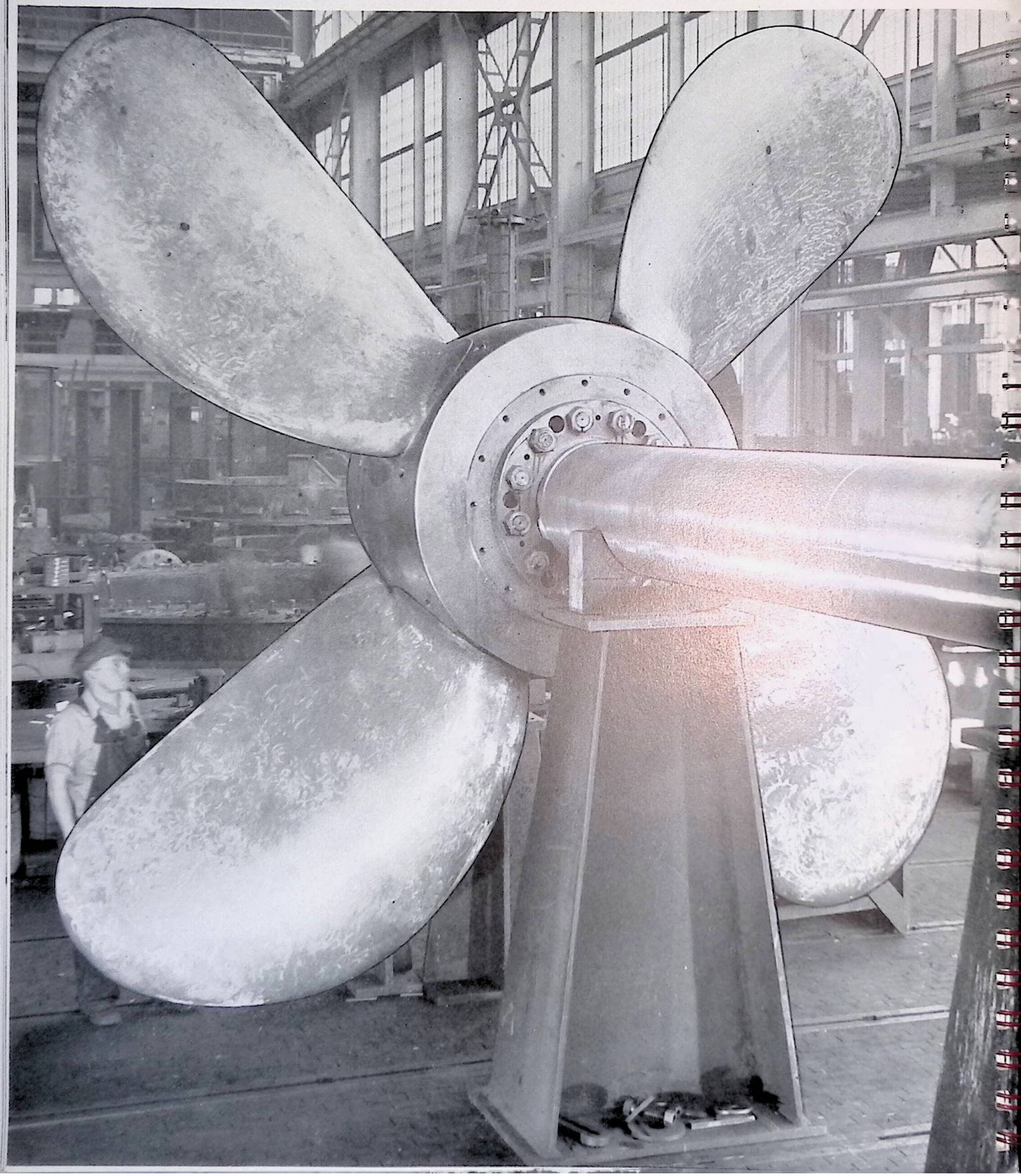


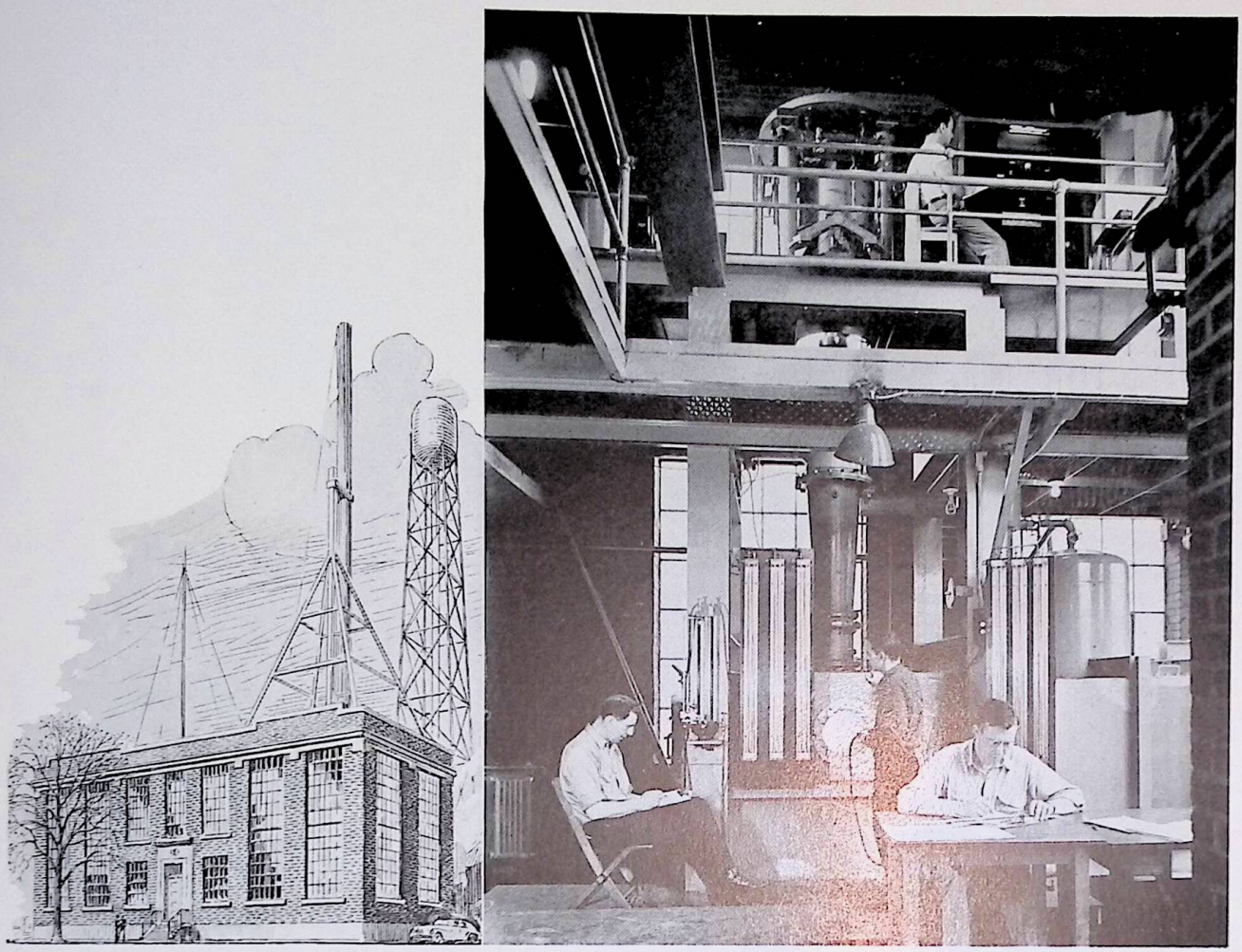


● Eighty-four-inch Controllable Pitch Propeller for the trawler "Albatross," Fish and Wild Life Service, U.S. Department of the Interior. 806 S.H.P., 300 R.P.M.



● Controllable Pitch Propeller, 210 inches in diameter, for installation on the U.S. Maritime Commission's Liberty Collier Ec 2-G-A-W2. This unit will absorb 3000 S.H.P. at 90 R.P.M. The vessel is driven by a gas turbine.





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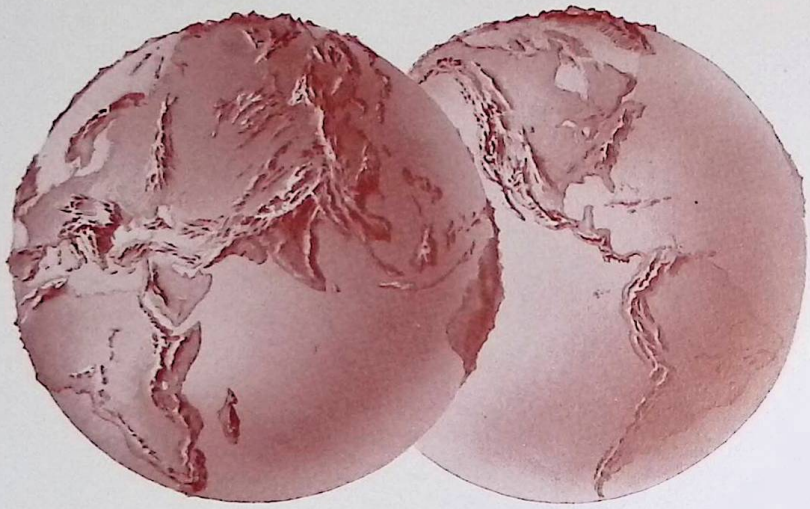

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